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## New York Fire-Alarm Telegraph.

When the Chief of the London Fire Department visited New York last year, he was accorded unusual facilities for inquiry into the system here in vogue. With no part of this system was he so profoundly impressed as with that relating to alarms. It was evident to him that Yankee ingenuity had discovered a means of reaching a given point, so to speak, by way of the hypothenuse, instead of the long circuit *via* the two sides of a triangle.

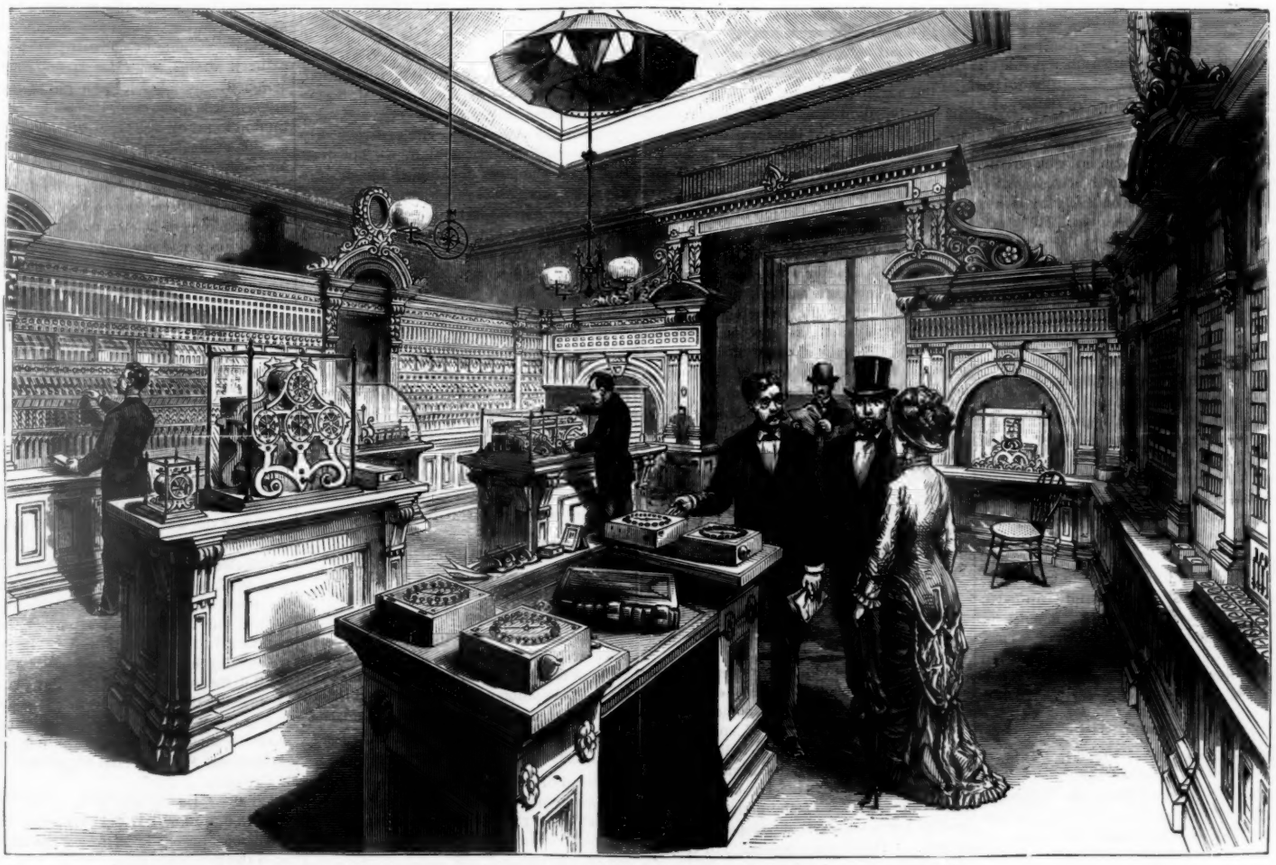
On his return home, however, the insular prejudice which seems to be inherent with the sons of Britain returned. Innovation of any kind, it is alleged, is distasteful in England, and Yankee innovation is intolerable. London's fire chief was not only dissuaded from his expressed intention of bringing the fire-alarm system up to the standard of efficiency which, as he had seen, was attained by the New York Fire Department, but, if the published reports of his utterances are to be relied upon, actually retracted much of the encomium which he had thought fit while here to bestow upon it.

Singularly enough, and as if in judgment upon him, two disastrous fires occurred within but a short period after his return to London—fires which all who understand the New York system of fire-alarm signals will agree would have been quite impossible in this city. This, of course, placed the London fire-chief in a most unenviable position, and, it is said, led him to change his mind once more, and, despite the prejudice of his countrymen, to be now reorganizing the London fire-alarm system upon the model of that now in vogue here.

The New York fire alarm telegraph system, which, there is reason to believe, is the best in the world, was designed by Mr. John H. Emerick, now Superintendent of the Postal Telegraph Company, and Mr. J. Elliott Smith. The theory upon which it is designed is that of announcing the location of a fire at the nearest engine-houses at the earliest possible moment. It is not required that one should be a professional fireman to comprehend this. If the curtains of your house catch fire, and you can get to them immediately, it is an easy matter to stop the flames. But should you be unaware of the fact, even for a few brief seconds, the woodwork in the neighborhood of the curtains will probably catch fire also, and what was only an insignificant flame, capable of being extinguished by one man, develop into a conflagration which ultimately will burn the house to the ground.

Recognizing this fact, Messrs. Emerick and Smith devised the present system wherein the importance even of parts of seconds of time in notifying the fireman of the whereabouts of a fire is made the base. So complete is this system now, that if you should sound a fire alarm from any box from the Battery to the Harlem River, you would have only time enough to shut it again and return the key to its place of keeping when the fire-engines would come thundering upon the scene of the conflagration. A very important feature of this system is that no one single wire is relied upon for sending an alarm. For accidents will happen to telegraph wires as to everything else, and where many lives are in peril and millions of property at stake, such chances very properly should not be taken.

The complete telegraph apparatus of the New York Fire Alarm Telegraph is laid out in the fire department headquarters, and besides its original cost of $11,000, has had many necessary additions since. The wires connecting it with the various engine-houses and police stations are carried exclusively on poles, for, owing to the many accidents to wires placed upon housetops, the electricians who had the matter in charge wisely considered it advisable to use them for the purpose of alarm wires. There are nearly five thousand of those poles, and about eight hundred miles of wire. These wires are divided into sixty metallic circuits, and instead of being grounded they are made endless. One circuit connects the headquarters with the gate-house of the Central Park reservoir. There 41 box circuits, 8 gong circuits, 4 conversational signals or talking circuits, 3 dial circuits, 2 tower circuits. Besides these there are box circuits in the annexed district, 550 street alarm boxes, the largest number of boxes and gongs, it is said, possessed by any city in the world, there being in company headquarters 64 large alarm gongs, besides those in the residences of the commissioners and the quarters of the battalion chiefs. At the battalion headquarters there are 18 dial instruments similar to those by which communication is maintained between police headquarters and the various police precinct station-houses. Over these talking circuits the exact time of departure and return of every fire company is



NEW YORK FIRE ALARM DEPARTMENT HEADQUARTERS.

sent to the fire-headquarters, and thus a complete over-sight is maintained.

A key-and-bell instrument is kept in each of the six tower look-outs, and thus the watchmen are enabled to receive and transmit signals to the department headquarters. The main apparatus of the fire-alarm service is placed npon a platform, and so arranged that any and all the office wires may be easily reached. The spare annunciator, spare register, automatic wire-testing instrument, and measuring instrument switch are placed upon the east side of this platform; while on the south are the main switchboards, galvanometers and rheostat (the measuring instrument). Opposite are the main registers, annunciator, relays, keys and fire levers. In the center of the platform there are several dais supporting repeaters or transmitters. To locate "crosses" and "escapes," the measuring instrument, switch and rheostat are used.

There are nearly 800 switches contained in the main switchboard, which is of marbleized slate, sixteen feet long and three feet wide. These switches are used, as may be supposed, in connecting extra batteries or instrument to the several wires and the like.

A small galvanometer is placed upon each circuit. This indicates at all times the condition of the wire and the strength of the corresponding battery.

A "cross" or "escape" being indicated, the circuit is switched to the rheostat galvanometer, and by this means the break is determined and repaired.

In the center of the keyboard is the recording instrument; and, in addition to a pen in each box-circuit, there is a "fire pen" centrally located, where are recorded in red ink all alarms from street boxes, in addition to the black ink registration made by the regular box-circuit pen.

Save when fire-signals are going or returning, the gong wires are kept on open circuit. Every ten minutes a current is sent over each of these gong circuits successively, by means of an automatic testing machine. This starts a small register, and registers the condition of each wire. The annunciator shows the number of the circuit over which the alarm is coming, whenever a street box is signalled for fire. Then the lever-switch, which throws the box into direct connection with the talking instrument in each company quarters, is pulled down by the operator, the register records the signal, and the operator, going to the transmitter, starts the signal over the gong wires, after pulling a stop-switch.

Upon the ground floor of the department headquarters are the batteries which supply this admirable system with electromotive force. They contain 200 wires, 1,250 cells of battery.

The above apparatus was made by Messrs. Pearce & Jones, who are certainly entitled to much credit for the excellent manner in which they have executed their work. They have also quite recently constructed an operating room, similar in design, on a much smaller scale, in Brooklyn.

### The Berthoud-Borel Electric Cable.

Mr. G. J. Lorrain gives the following particulars, derived from a visit to the factory in Switzerland, where the cables are made:

The insulating material now employed is formed of oxidized linseed oil specially treated. Oxidized linseed oil, that is, linseed oil heated in contact with air until it assumes a gutta-percha like mass, has, I believe, been tried before, but as an insulating material it is far from perfect. By the Berthoud-Borel process, however, a very excellent and cheap insulating material is obtained. Linseed oil is gradually heated up to a temperature of about 610° Fah., and at a certain stage of the operation, which the workman recognizes by the appearance which the viscous mass presents, colophane treated with oil is added, and the operation continued till the desired consistency is attained. A firm, coherent, and elastic substance resembling india-rubber is obtained.

The most interesting and by far the most important feature in connection with these cables is the method of manufacture and the machinery employed therein. The cables are not manufactured first and then inserted in lead coverings. The process is almost entirely automatic; you literally see the wire passing into the machine at one end and issuing at the other in the form of a complete cable, protected by its lead sheathing. The lead is put on in a molten condition, and the cables can be made of any desired length, however long. When the cable is meant to be laid underground, it is passed through the lead press a second time, receiving a second coating of lead, with a thin coating of gas tar between the two. Cables thus formed can be laid underground without being incased in iron pipes and without further protection. The insulating material employed, as it is not effected by alternations of temperature, admits of these cables being laid in troughs along the curbs of the streets, and close to the surface.

A noticeable feature of the factory is its quiet and holiday aspect. This is due to the small number of workmen required to look after the machinery.

### Self-Induction in Dynamos.

On the subject of self-induction in dynamos, we extract the following from our esteemed contemporary, *Engineering* (London), which will be found worth noting, so far as it refers to the loop form of coil used in several well-known styles of dynamos:

"In the Hopkinson-Muirhead and Thomson-Ferranti dynamo-electric machines the loop form of coil is adopted with good effect, and the advantage gained is usually attributed to the diminished non-effective resistance of the coil. But this form of coil was, we understand, adopted originally by Dr. Muirhead not only for the reduced non-effective resistance which it offered, but for the diminished self-induction in the coil. In an open coil of this kind, self-induction is less than in a closed coil. The self-induction in dynamos is a factor which has been overlooked in their construction, and must operate considerably in reducing their efficiency. No dynamo, as now made, has the theoretical efficiency it ought to have, even allowing for waste by heating in the coils and Foucault effect. The reason, or at least one reason, of this is, as Dr. Muirhead has observed, probably due to the self-induction in the coils. Actual measurement of this quantity shows that in the Hopkinson-Muirhead loops it is less that in closed bobbins. Inventors will do well to turn their attention to this subject with n view to diminishing the self-induction in dynamos."

### Rarefied Air as a Conductor of Electricity.

Edlund continues his researches upon this subject. A number of experiments are described to show that the phenomena of the opposition to the passage of sparks from terminal to terminal in rarefied air cannot be explained by the theory that a vacuum does not conduct electricity. He carefully discusses the question of the contrary electromotive force which is developed at the terminals. "It is not the resistance of the gas, but this electro-motive force, increasing with the rarefaction and connected with the electrodes, that presents an obstacle to the passage of the current. Everything is in favor of the hypothesis that vacuum opposes a very feeble resistance to the propagation of electricity." Without the employment of electrodes, one can excite an induction current in a Geissler tube, which is sufficient to produce light. This would be impossible if the highly rarefied gas or vacuum were an insulator.

Telephone stocks are held very largely in Chicago, where they command high figures. Indianapolis does not come far behind, as people there are investing in them for permanency.

### On the Action of Iron as a Magnetic Screen.

(*Translated from La Lumière Electrique.*)

Certain theories of dynamo-electric machines in general, and of the Gramme machine in particular, are based on the fact that a mass of iron introduced into a magnetic field performs there the function of a screen; that is to say, suppresses the magnetic field behind it (*behind*, being of course estimated in starting *from* the pole of the magnet which produces the field). It is a fact that in these machines an action of this sort is, or appears to be, exercised; but how? To what is it due? Simply to the presence of the iron, to its mass? or to its form?

These questions are not completely elucidated.

M. J. Stefan has recently made an experimental and analytical study of these questions, the results being published in the *Annalen der Physik und Chemie* of Weidemann, December 2, 1882.

M. Stefan first recalls the fact that Poisson in applying mathematics to the theory of magnetism, recognized that a hollow sphere of iron submitted to magnetization gave in its interior effects much feebler than on its exterior surface, and thus acted in the fashion of a screen. This fact is analogous to the result which is produced when a hollow sphere of conducting metal is submitted to electrical inductive action. Yet the form of the body makes no difference, and if a sphere has been more especially considered it is; first, because the effect is produced therein more clearly; and, secondly, because this shape lends itself more readily to calculation.

Instead of choosing this form, M. Stefan has preferred to use that of rings and cylinders, because they resemble more closely the shapes of the parts actually used in practice in the machines mentioned above. He has made three series of experiments.

The first is in respect to the deviations produced at a distance on a suspended magnetized body. M. Stefan has taken for the magnet producing the deviation, a little magnet of 5 centimeters* long by 1 centimeter diameter, which was placed at 31 centimeters distance from an Edelmann galvanometer needle, which was thereby deflected 116°; without changing the other conditions, M. Stefan passes around his magnet a cylinder of soft iron 5 centimeters long, having an exterior diameter of 13 centrimeters, and an interior diameter of 11 centimeters, and the deflection falls to 22°. The experiment, repeated at different distances with another magnet and another cylinder, gives results similar in kind.

It will be remarked that the cylinder of iron acts in this fashion, even if its medial section does not coincide with the axis of the magnet, of which the following is an example:

The apparatus being arranged, as described above, $h$ is the distance in centimeters between the medial section of the cylinder and that of the magnet, and $l$ deflections are obtained—

| | | | | | | |
|---|---|---|---|---|---|---|
| $h=$ | 0 | 2.5 | 5 | 7.5 | 10 | 12.5 |
| $l=$ | 22 | 35 | 65 | 90 | 102 | 110 | 116 |

Instead of a cylinder of soft iron, M. Stefan has made use of a disc 13 centimeters in diameter and 12 millimeters in thickness; by placing it above the magnet the deflections are equally reduced, and, as before, the action is as much more feeble as the distance between the disc and magnet is greater. The disc can also be placed at the side of the magnet, so that its horizontal diameter is parallel to the axis of the magnet, the effect is the same; but if the disc is placed in front of, or behind the magnet, then there is no longer an enfeeblement, but, on the contrary, a slight increase of the deflection.

Before following any further the facts established by M. Stefan's experiments, it will be convenient to consider a moment those just described, especially as they already permit of important conclusion being drawn therefrom.

It will first be remarked that, with the exception of the last experiment cited, the mass of iron introduced into the magnetic field has never been placed between the pole of the acting magnet and the deflected needle, which leads to the conclusion that the term *magnetic screen* ought only to be used with a certain reservation; this term carries, in fact, the idea of an obstacle interposed on the line which joins a center of action to the object submitted to that action. This is not the case. No matter what may be the position of a mass of soft iron in the magnetic field, its effect is felt; very generally its action is effected in the diminution of the magnetic influence at a distance; but, as is demonstrated in the last experiment, the contrary may take place.

Moreover, the experiment is very easy to repeat and requires no particular caution. It is sufficient to provide, as we have done, any magnet—for example, the magnet of a telephone, a galvanometer needle, even a not very sensitive one—and a small piece of soft iron.

By the aid of the magnet placed at some distance from it, the needle is deflected a certain number of degrees. In placing the soft iron at the side of the magnet, this deflection always diminishes, more or less, according to the relative masses and positions. If the soft iron be placed between the pole of the magnet and the needle, the effect is more complex. By first placing it far from the pole of the magnet and near to the needle, the deflection is diminished. The soft iron then acts really like a screen, as it comes nearer and nearer to the magnet. When it has arrived near enough to the latter, the deflection is again augmented; at a certain point it attains the value it first had; the action of the mass is then *nil*, and at this moment it is quite near the pole. In continuing to move nearer to the pole, the deflection augments beyond its first value, as Mr. Stefan has also observed.

This experiment, however rough and incomplete it may be, shows well enough what the phenomenon is. In reality there is no screen, properly so called. As M. Stefan says in his *Memoire*, "the action consists in the modification that the introduction of a mass of iron produces in the distribution of the magnetic forces." This modification is variable and depends on complex causes, and the name of *magnetic screen* appears badly chosen for designating it.

The second series of experiments made by M. Stefan is based on the duration of the oscillations of a magnetized needle, first moving freely in the terrestrial magnetic field, and afterward surrounded by a cylinder of soft iron. It is observed in the second case, that the duration of the oscillations is greater, which shows that the magnetic field is enfeebled in the interior of the cylinder. This teaches us nothing new. It is one of the cases of the theory of Poisson cited above; but M. Stefan has pushed the experiment further, and shows that the action was analogous when the cylinder was not around the magnetic needle, but above it. If we call $h$ the distance between the median line of the cylinder and the plane of the needle in centimeters, and $t$ the duration of the oscillations, M. Stefan has found the following results:

| | | | | | | |
|---|---|---|---|---|---|---|
| $h=$ | 0 | 1.25 | 2.5 | 5 | 7.0 | 10 |
| $t=$ | 13.6 | 12.8 | 11.0 | 8.4 | 7.4 | 6.6 |

The conclusions to be drawn are the same as in the preceding case.

The third series of experiments has had for its subject inductive action.

The inducting field was first derived from terrestrial magnetism.

In this case we arrange a bobbin in such a fashion that its axis may be perpendicular to the plane of the magnetic meridian, and while keeping it in that direction, if it be made to enter a cylinder of soft iron, an induced current, although a very feeble one, is manifested. The action is only plainly apparent by making use of a more powerful magnetic field. With this object in view M. Stefan has employed an electro magnet of the species devised by M. Faraday. If a bobbin is brought within a magnetic field, there is produced within it a current by induction; if a cylinder of soft iron is slipped

*1 centimeter=3937 inch. Translator.

over and around the bobbin, an induction current in the contrary direction is produced.

In the preceding experiment the plane of the windings of the bobbin is perpendicular to the direction of the lines of force. Another experiment can be tried by disposing the plane of the windings parallel to the direction of the lines of force, and between the windings is placed a plate of iron; by placing over this plate a ring of soft iron, we obtain an induction current of which the direction varies according as the windings are near or far from either side of the plate.

The most significant results are those obtained by winding spirals of wire lengthwise on the sides of a cylinder parallel to the generators, in a manner similar to that which is adopted in the Pacinotti ring and in the Gramme machines. This arrangement, being placed in the previously described magnetic field, the wire is first made to revolve around the axis of the iron cylinder, and a current is produced. There is also a current produced if we turn at the same time the wire and the cylinder, as occurs in the case of dynamo-electric machines; but if we leave the wire immovable and revolve the cylinder alone, no current is obtained. It should be remarked here that these observations, as well as those preceding, are based upon the supposition that the cylinder of iron has no residual magnetism. It is necessary to be assured of this, and, if there be any, to make allowances for it in the manner M. Stefan indicates.

The experiment may be modified by revolving the wire and the cylinder around different axes, or in giving to one or the other, relatively, a movement of translation. In the latter case, if we give a common movement of translation to the cylinder and the wire, there is no current produced; the latter being only produced when there is a relative displacement of the two parts.

The latter observation is curious. In fact, if the experiment be examined, we see that the portion of the conducting wires which is inside of the cylinder moves in a feebler magnetic field than the portion situated on the exterior. It therefore appears, at the first glance, as if there should be a current; but a more careful examination shows that this conclusion is erroneous, as is shown by the experiment. "In causing the cylinder to move in the field," says M. Stefan, "the lines of force (which may be considered as physical lines) move from the front part of the tube to the posterior part, so that the wires situated on the interior of the tube cut them as much as do the wires situated at the exterior, and there is no current." In order to verify this conclusion, M. Stefan has devised the following experiment: Place on a plane surface two semi-circular pieces of copper, placed with their planes parallel to the plane of the magnetic meridian. These two curves are joined by a rod of copper, which is thus placed perpendicular to the meridian. By sliding this rod over the metallic curves, he obtains a certain current, and measures its strength. The rod is then surrounded by an iron tube, the movement is renewed, and exactly the same current is obtained.

It follows from these experiments that the movement of a closed circuit in a homogeneous magnetic field produces no current, even if a part of the circuit is surrounded by a tube of iron; all of which can be directly demonstrated.

We discover here a proof of the error into which many have fallen in the early times of telephone installations, in endeavoring to avoid induction by means of tubes of iron or lead. Experience has proved the worthlessness of these devices, which could have been foreseen theoretically, and which M. Stefan has succeeded in proving. In this case the iron does not act as a screen at all.

To these experiments made by M. Stefan may be added an experiment by M. Marcel Deprez, as follows: Take a ring of the Gramme pattern, surround it with an iron cylinder, and cause it to revolve. There will then be presented a magnet, successively, outside of the cylinder of iron and inside of it. In the two cases the induction is produced sensibly with the same intensity. To be exact it will be necessary to take account of the difference in distance. The experiment has not been carried to this point, but, such as it is, it shows that the envelope of iron does not act as a screen.

Moreover, the very interesting experiments made by M. Stefan, and the analytical study with which he has accompanied his *Memoire*, does not appear to give a complete solution of the phenomenon. The facts which he has observed very usefully enlighten various points, but do not constitute a methodical exposition of the subject in general. I have observed, for instance, that the actions are modified, and sometimes completely reversed, according to the relative positions and proportions of the masses used. It does not appear that these sides of the question have been examined. There is a field open for a more complete and more analytical investigation. Nevertheless, M. Stefan's work remains a conscientious study and a useful work of reference.

In any case, we may conclude that the name *magnetic screen* is inexact, and ought not to be employed—at least, only with great reserve and in a very general sense. We should rather say a "means of modifying the magnetic field."

FRANK GERALDY.

## Electro-Motors.

SOME OBSERVATIONS ON THE DETERMINATION OF THE WORK EFFECTED BY ELECTRO-MAGNETIC MOTORS.

BY A. VON WALTENHOFEN.

While Jacobi (1840) has furnished us with the foundations of a theory of electro-magnetic machines, Grove (1844), Joule and Scoresby (1847), and W. Petrie (1851) must be mentioned as the first who have given us exact information concerning the work effected by electro-magnetic motors. For this purpose the above-mentioned physicists started from the first principle, viz., to compare the theoretical consumption of zinc requisite for the maintenance of one horse-power with that which was actually expended per horse-power by the motors employed in the above-mentioned experimental determintion of the work effected and consumption of zinc. Out of all these results only those of W. Petrie can be looked upon as resting on reliable data, for those of the other physicists before mentioned give such an enormously high return of work that its inaccuracy can admit of no doubt when tested by the knowledge that we possess at the present day of the capacity of work of the best electro-magnetic motors. W. Petrie is also the only one who clearly and expressly states in his report that he has duly taken into account that the theoretical work effected in proportion to the unit of weight of zinc depends upon the nature of the circuit in which the consumption of zinc takes place, and also the only one who has strictly applied the principle just laid down for determining the return of work.

This principle, viz., the equivalent of work (to be looked upon as effective work) of the chemical processes taking place in the generating battery, is simply the one that I have myself maintained in a form which, although quite different, is in accordance with these more recent investigations. On the other hand, my mode of procedure in my experiments was quite different to the earlier methods.

In the first place, in the reports of the physicists in question the returns of work effected were measured directly on the machine, in foot-pounds, by means of the raising of weights, whereas I first employed the break dynamometer for the testing of electro-magnetic motors. In the second place, the consumption of zinc was formerly measured by weighing the plates of zinc before and after the experiments; whereas I, instead of employing this clumsy and roundabout method, took the measurement of the current by means of the tangent galvanometer, in order to reckon from the product of the current and the known electro-motive force of the battery, the effective work in kilogrammeters per second, and from the comparison of the effective work so determined with the work measured by means of the break dynamometer to deduce the efficiency of the electro-magnetic machine to be tested.

The theoretical explanation of this method of procedure, which I gave at the time, also follows from the formula communicated by Clausius in a note on the relation between the chemical action of a voltaic pile and the work effected by the current. Let $J$ represent the battery current in the motor which is in working order, but which is stationary, and $J - i$ the battery current during the working of the motor, therefore $i$ the counter-current induced by the working of the motor, and $\lambda$ the total resistance of the current circuit, we get the equation:

$$J\lambda(J-i) = i\lambda(J-i) + (J-i)^2\lambda.$$

In this equation the first term represents the current work given off from the battery when the motor is driven or the total work, D; the second, the mechanical work performed in the machine, consisting of useful work, N, and of friction, R; and the third, the current work, W, entering into the circuit as heat. The degree of efficiency is as N : D. In order to find D, we now use my method of measuring the current during work, $J - i$, by means of the tangent galvanometer, while $J\lambda$, the electro-motive force of the circuit when the motor is at rest, is the known electro-motive force of the battery.

A very simple example of the above formula is afforded, as I have shown, by the observation of the rotation of the pole of a magnet round an electrode.

## International Electric Exhibition, Vienna, 1883.

(*From Our Special Correspondent.*)

Looking at the announcements which have come in within the last few days, even but superficially, we must state that the International Electric Exhibition in Vienna will not at all be inferior to its predecessors, but on the contrary, will in many respects surpass them.

Continuing our last sketch we can only mention some of the more important applications, the latter being too numerous. Two countries—Denmark and Spain—have made their appearance of late, and likewise Italy has sent a great many applications. We mention of the exhibitors of the latter state only the "Societa Anonima Generale Italiana dei Telefoni" at Naples, with a rich collection of lighting apparatus and telephones; Messandro Lucchesini and Jules Lorenzetti, at Florence, with various telegraphic apparatus; Rialti Vincenzo, at Forli, with a great many novelties in incandescent lamps; Dr. Charles Labus, at Milan, with his laryngofântomie for demonstrating laryncoscopic operations; and Dr. Samuele Salaghi, at Rome, with electro-therapeutic apparatus. We then mention France, which promises to send representatives in a most imposing manner. Above all the new-comers stands the Maison Breguet and L. Sautter, Lemonnier & Co. at Paris, world-renowned firms of which France possesses several, and whose exhibits represent an exhibition by itself. The former firm representing one of the oldest institutions in building telegraphs, have, however, joined the rapid extend of electrotechnic, and are manufacturing at present with equal exactness and elegance, lamps, dynamo machines, galvanoplastic apparatus, etc., as they formerly manufactured the needle telegraphs, Morse, Hughes, and other instruments. The exhibition of L. Sautter, Lemonnier & Co., whose lighting apparatus for field purposes and sea lighting enjoy a well-deserved reputation, will contain a light-house, the beams of which, if it will follow its type at Paris, will enliven the vast space of our rotunda. Besides, they have promised to send 8 dynamo machines, 10 large reflecting apparatus, and a great number of electric lamps. Next to them we add among others Lazare Weiller, at Angouleme, with various executions in silicium, phosphor bronze and copper wire, and Ch. Ferd de la Roche, at Paris, with regulators and incandescent lamps. Only passing Switzerland quickly, from which Emil Burgin, at Basel, the Swiss Edison, promises to send in connection with the London firm (R. E. Crompton & Co.) important novelties, we greet from Denmark Paul la Cour, at Askovhus, the inventor of the turning hammer telegraph, and Wilhelm Hellesen, at Copenhagen, inventor of an interesting telephone, promising to send, however, this time, a novelty in another department.

With pleasure we turn to Germany, our nearest neighbor, where the zeal for exhibiting is getting to be more and more active. We mention according to the chronological succession of the announcements the firm Keiser & Schmidt at Berlin, who, according to their announcement-sheet, will not stay behind their beautiful exhibition at Paris; the Rhenische Electricitatsgesell shaft at Mannheim, with new patented lamps; C. H. F. Müller, at Hamburg, with electric lamps, Crooke's apparatus, and so on; Heilmann-Ducommun & Steinlen, at Muhlhausen, whose exhibition at Paris raised the undivided amazement of all visitors, and who are going to erect a pavilion of their own demonstrations, the transmission of power from a distant source to various machine tools; the Oberstabsarzt Dr. Emil Boettcher, at Leipsic, who raised surprise by the spiritual construction of an accumulator, which after its unloading keeps on working as a primary galvanic element, and who has promised to send to Vienna four new secondary batteries; Josef Zimber, at Furtwangen (Baden) with a stately collection of electric clocks; Michael Sendtner, at Munich, with his electric thermometers; Grenier & Friedrichs, at Stutzerbach (Thuringen) with incandescent lamps of his own system; Dr. Greitner's argentan-factory at Auerhammer (Saxonia) with a picturesquely arranged exhibition of different metallic cables, plates, etc., for electric purposes; E. M. Reiniger, at Erlangen, with a very rich collection of electro-medical apparatus; Dr. Albert Lessing, at Nurnberg, with electric coals and apparatus; Dr. Johann Wilckens, at Bremen, with a type-printing telegraph of the deceased inventor, G. T. Droste, and Spiecker & Co., at Cologne, with dynamo-electric machines for the purpose of electric lighting and transmission of power.

We shall do justice to the announcements from remote countries, as well as to the legion of exhibitors before long, of whom we can state to-day that they will be represented in every department of electrotechnic with the most modern constructions.

In following the development of electric engineering, all the world is learning new terms and new language. Words which three years ago either did not exist, or were understood only by men of science, are to-day in the common language of engineers and their workmen—to-morrow will be used by the general public. "Electromotive force" and "current," "volts" and "ampères" are becoming terms as well known as "pressure of water" or "cubic feet of gas," and it is necessary that this should be so, as the time is fast approaching when the public will find their quarterly bills for the supply of electricity made out in "volts" and "ampères," and will have a right to sue their local electric company if their daily supply of "current" is insufficient, or is given at a wrong "electromotive force."

New York State, in the vicinity of Portage, is all excitement over the discovery of salt deposits at Warsaw. The crystal vein is nearly 100 feet thick, and probably 1,500 or 2,000 feet below the surface. The territory supposed to be rich in this commodity is, as has been shown by frequent sinkings, several miles long and a mile or more in width. The brine is double the strength of that of Saginaw or Syracuse, and is found to contain that peculiar quality needed for the production of soda-ash, for which we have hitherto been dependent on Europe, and which we have bought to the extent of many millions yearly. The salt operators are in a fever of excitement over the discovery.

## The Electro-Amalgamation of Gold Ore.

We extract the following interesting remarks upon electro-amalgamation from *Engineering:*

In gold mining from quartz reefs the rock is, as is well known, reduced to powder by means of stampers, and is then carried by a stream of water over the surface of mercury. In consequence of the strong affinity between gold and mercury, as soon as a particle of the former comes in contact with the latter it is absorbed and amalgamated, while the quartz fragments, with which it is associated, float on the surface of the metal, and are carried away by the stream of water. But besides gold many other substances, such as oxygen, sulphur, and arsenic, have an affinity, more or less active, for mercury, and many, if not all, of them are found mixed with the gold in certain deposits. When an ore containing these elements is passed over mercury to eliminate the gold, the other bodies are also retained, and being of much smaller specific gravity than the mercury, they float on its surface, combining with its upper stratum, and adhering with a persistence that cannot be overcome by any stream of water that is not of sufficient force to carry off not only the quartz, but also the gold and part of the mercury. This result is termed by the miners "sickening," and involves great loss of gold, because as soon as the surface of the mercury becomes "sick" the gold no longer comes actually into contact with it, and the greater part escapes. The remedy hitherto employed has been to remove the sick mercury at frequent intervals and distil it, exactly as water is distilled, but this of course involves additional expense, and in many mines the extra cost, and the loss which takes place, in spite of all care, are sufficient to convert a profit into a loss.

Lately Mr. Richard Barker, F. G. S., has brought out a new method of recovering sick mercury, or rather of preventing it becoming sick. According to his process, he connects the mercury to the zinc pole of a galvanic battery, or of a dynamo machine, and the water flowing over it to the copper pole of the same generator. Thus he gets a current of electricity flowing from the water to the mercury. The result is certainly very surprising; immediately contact is made, the black scum accumulated upon the surface of the mercury retreats from the electric terminal, as if driven by a steady blast of air, and the bright surface of the metal is exposed to view ready to receive anything that passes over it.

This is by no means the first time that attention has been called to the peculiar behavior of mercury when acting as an electrolytic surface. In the early part of the century, Gerboni, Herschel and Davy noticed it; in 1875 Sir Charles Wheatstone patented a telegraphic instrument in which the indications resulted from the motions of a column of mercury under varying currents, and a little later Mr. Robert Sabine made a thorough investigation of the subject. He found that when water is placed upon the surface of mercury the latter immediately becomes converted into suboxide, if it be not already so. If the water and mercury be then connected to the battery, in the manner described above, the suboxide is reduced, and the surface becomes metallic. With powerful currents, this action, owing to the difference in bulk of the metal and the oxide, is accompanied with rapid circulation of the metal. If a globule of mercury be placed in a narrow groove filled with water so as to divide it into two parts, and a current be passed lengthwise through the groove, one end of the globule will be continually converted to suboxide, and the other deoxidized. Now, as the atomic value of the mercury is 14.7, and that of the suboxide may be taken at 28.9, there is a great expansion at one end of the globule, causing a mechanical circulation of its molecules from the larger to the smaller end and a rolling action which carries the mercury bodily forward in the direction of the current.

Applying these facts to the explanation of the action of Mr. Barker's electro-amalgamator, it will be seen that there is a constant electrolytic action going on at the surface of the mercury, and that when this is exposed to water only, the process is simply a deoxidizing one. When, however, sickening ores are passing over the mercury, the action of the current will be to break up any combination that may take place between the mercury and such of their elements as are included in the list of substances which, under the influence of electrolysis, are carried to the anode. These are the metalloids, such as oxygen, sulphur, chlorine, boron, carbon, and perhaps arsenic. It is not distinctly known what is the exact cause of the sickening of mercury, but there is good reason to believe that sulphur and arsenic are the most potent agents in the matter. Hence, while their chemical affinity would cause them to combine with the mercury, their electro-negative condition prevents their union with its electrolytic surface, when a current is passing through them. On the other hand, the combination with the mercury of all the negative metals, gold, silver, copper, tin, lead, nickel, zinc, etc., would be favored by the current.

It will thus be seen that the action of the electric current in an amalgamating riffle tends to prevent the combination and adhesion of any electro-positive elements to the mercury, and to leave the quartz, with the sickening ores, floating mechanically on its surface, ready to be carried off by the current of water. This effect is being exhibited by the Electro-Amalgamation Company (Limited), of 37 Lower Chambers, Moorgate, London, on a considerable scale. They have fitted up several amalgamating apparatus, consisting of inclined tables about six feet wide, with riffles or baths of mercury placed at intervals. The bottom of each riffle is of copper, and is connected to one pole of an Elmore dynamo machine, while over the top, separated from the mercury by a space of about half an inch, is another plate of copper, connected to the other pole of the generator. A stream of water carries the pulverized ore down the table and between the mercury and the upper plate, the dirt being carried forward by the current, and the gold retained by the bright, clean surface of the mercury. In some cases stirrers and rakes of various kinds are adopted in place of the upper pole plate, according to the nature of the rock treated.

But the attainment of a clean mercurial surface is not all that stands between the gold miner and success in amalgamation. Much gold is "rusty," that is, it is coated with a skin or pellicle of sulphuret, probably from contact with sulphuretted hydrogen. A piece of such gold may be immersed in perfectly pure mercury without any amalgamating action whatever, and consequently the mercurial process has hitherto been useless for its recovery, and rusty ores have been smelted. This raises the cost of milling in Colorado from $1.50 to $15 per ton of dirt, a notable difference.

The company claims that the new process is effectual for causing the amalgamation of rusty ores, but they do not offer any satisfactory explanation of the action by which it operates beyond stating that "by electric action the gold and silver are driven to the negative pole, and * * * * it is obvious that the natural gravitation of the gold and silver is so assisted by the attraction of the electric force as to allow but few, if any, of the particles to escape." This can scarcely be called a scientific explanation, but we understand that a considerable consignment of rusty ore is on its way, and then the result may be determined by actual experiment. If successful in this respect, Mr. Barker's invention promises to be extremely valuable, while, under any circumstances, its power of maintaining the surfaces of the riffles free from contamination, if found to be as effectual in actual practice as in experiment, must open to it a wide field of usefulness.

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An engineer stopped his train near Waterville the other day within a foot of a man whom "God had commanded to kneel and pray on the railroad track." The railroad man was mad, but gave the crank a time-table and moved on.

## American Manufacturing Interests.

The following table from the Census Bureau shows the capital invested and the value of products of all the establishments of manufacturing industry, gas excepted, in each of the States and Territories, as returned at the census of 1882:

| | Number of Establishments. | Capital. | Value of Products. |
|---|---|---|---|
| Alabama | 2,070 | $9,668,008 | $13,565,504 |
| Arizona | 66 | 272,600 | 618,365 |
| Arkansas | 1,202 | 2,953,130 | 6,766,159 |
| California | 5,885 | 61,243,764 | 116,218,973 |
| Colorado | 599 | 4,311,714 | 14,260,159 |
| Connecticut | 4,488 | 120,490,275 | 185,697,211 |
| Dakota | 251 | 771,438 | 2,373,970 |
| Delaware | 746 | 15,655,892 | 20,514,439 |
| District of Columbia | 971 | 5,552,536 | 11,892,316 |
| Florida | 436 | 3,210,690 | 5,546,448 |
| Georgia | 3,593 | 20,672,410 | 36,440,948 |
| Idaho | 162 | 677,215 | 1,271,317 |
| Illinois | 14,549 | 140,652,066 | 414,864,673 |
| Indiana | 11,198 | 65,742,962 | 148,006,411 |
| Iowa | 6,921 | 33,987,886 | 71,045,936 |
| Kansas | 2,803 | 11,192,315 | 30,843,777 |
| Kentucky | 5,328 | $45,813,039 | $75,486,977 |
| Louisiana | 1,553 | 11,463,468 | 24,305,188 |
| Maine | 4,481 | 49,988,171 | 79,829,793 |
| Maryland | 6,787 | 58,743,384 | 106,780,563 |
| Massachusetts | 14,352 | 303,806,185 | 631,135,284 |
| Michigan | 8,873 | 92,930,959 | 150,715,025 |
| Minnesota | 3,493 | 31,004,811 | 76,065,198 |
| Mississippi | 1,479 | 4,727,600 | 7,518,302 |
| Missouri | 8,592 | 73,507,844 | 165,386,205 |
| Montana | 196 | 899,390 | 1,835,967 |
| Nebraska | 1,403 | 4,883,150 | 12,627,336 |
| Nevada | 184 | 1,923,300 | 2,179,626 |
| New Hampshire | 3,181 | 51,112,963 | 73,978,028 |
| New Jersey | 7,138 | 106,226,593 | 254,380,236 |
| New Mexico | 144 | 463,375 | 1,284,846 |
| New York | 42,739 | 514,246,575 | 1,080,696,596 |
| North Carolina | 3,802 | $13,045,639 | $30,095,087 |
| Ohio | 20,699 | 188,939,614 | 348,296,390 |
| Oregon | 1,080 | 6,312,056 | 10,931,232 |
| Pennsylvania | 31,392 | 474,510,903 | 744,818,445 |
| Rhode Island | 2,905 | 75,575,943 | 104,183,621 |
| South Carolina | 2,078 | 11,205,894 | 16,738,008 |
| Tennessee | 4,326 | 20,092,845 | 37,074,886 |
| Texas | 2,906 | 9,245,561 | 20,719,928 |
| Utah | 640 | 2,696,657 | 4,824,992 |
| Vermont | 2,874 | 23,265,224 | 31,354,366 |
| Virginia | 5,710 | 26,968,990 | 51,790,992 |
| Washington | 261 | 3,202,497 | 3,250,184 |
| West Virginia | 2,375 | 13,883,390 | 22,867,126 |
| Wisconsin | 7,674 | 78,821,902 | 198,255,480 |
| Wyoming | 57 | 384,673 | 808,404 |
| The United States | 253,852 | $2,790,272,606 | $5,369,579,191 |

## The Edison System in Europe and America.

Up to the 20th of December last 29,192 Edison lamps were in use in America. Up to the commencement of February 19,536 lamps were in use in Europe.

## Insulating Wire.

A new method of insulating wire for electrical purposes has recently been adopted by the Triplex Insulated Wire and Rubber Company. The method consists in tinning the wire; it is then covered with a layer of soft rubber, around which a strip of soaked linen is wrapped, and which in turn is covered by an outer layer of thick, hard rubber. For underground wires another layer is added. The process of manufacture of this insulated wire is very simple, all the layers being put on in one operation by means of machinery, thus making it possible to furnish a comparatively cheap article. The wire is fed from a reel into a groove cut upon two steel rollers heated with steam, and simultaneously two strips of soft rubber, each more than covering one-half of the wire. The excess of rubber is stripped. The coated wire is then automatically wrapped with soaked linen strips, and is carried to a second set of rollers, where two strips of hard rubber are united around it to a third coating.

## Electricity: its Characteristics and Uses.

The second lecture under this title was delivered by Mr. J. H. A. Macdonald, Q. C., before the members of the Edinburgh Philosophical Institution recently. Beginning by referring to the relation between magnetism and electricity, the lecturer explained and illustrated the different characteristics of magnets—some of these being that the power they possessed developed itself at the ends only, and in opposite degrees at each end; that magnets could be produced by electricity, and that in electrical magnets their power was displayed in certain regular lines of force. The principle upon which dynamo machines generated electricity was also explained, as was likewise the system of accumulating electrical energy by storage batteries after the Faure-Sellon-Volckmar method. Turning to the uses of electricity, the lecturer explained the telegraph, telephone, microphone, the various kinds of electric lamps, &c. This lecture, like the preceding one, was illustrated by numerous diagrams, apparatus and experiments. The portion of it dealing with electric illumination was illustrated by a number of Lane-Fox incandescent lamps, supplied from 25 accumulators of the Faure-Sellon-Volckmar patent, made by the Electrical Power Storage Company, London. A 1,500 candle-power arc "Brush" lamp, fed by a dynamo placed in Messrs. Constable's printing establishment, near at hand, was suspended from the roof of the hall.

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The system of electric lighting with Swan lamps, recently adopted on board the French ironclad *le Redoubtable*, is thus described: There are four Gramme machines of the type of 500 Carcel burners, so called, each driven by a Brotherhood engine. The steam is supplied to each motor by an auxiliary boiler, at a pressure of four atmospheres. Each machine feeds a circuit containing fifty-one lamps. The first circuit, called the *circuit de rade*, is meant to work in the roadstead; the second, or *circuit de mer*, at sea. The machine-chamber, lit in the roadstead by twelve lamps in the first circuit, is lit at sea by thirty-seven lamps in the second. The third and fourth circuits are called *circuits de nuit* (night circuits.) One of these lights part of the ship where light is indispensable at night; the other chiefly lights officers' cabins, and supplements the lighting by the first night circuit. This second night circuit affords, as required, lights for the course (*feuz de route*) and signal lights; the former being six in number, and equivalent to eighteen of the ordinary lamps used in lighting the ship; the signal lights are ten in number and equivalent to thirty ordinary lamps. With two commutators, one set is exchanged for the other in either case.

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They are now experimenting with paper as a substitute for steel rails. Why not? Rails are stationary.

## The Progress of Telegraphy.

By W. H. Preece, F.R.S., M.I.C.E.

*Read at the Institution of Civil Engineers.*

Telegraphy is the oldest practical application of electricity. Electric currents are, as a rule, maintained for telegraphic purposes by the combustion of zinc, and in the innumerable forms of batteries the conversion of zinc into sulphate of zinc is the root of the transformation of energy into that form which was utilized as electric currents. There are three forms of battery in use in the British Post Office telegraph system, and in the following numbers: Daniell, 87,221 cells; Leclanché, 56,420 cells; and Bichromate, 21,846 cells.

Every administration has its own adopted form, differing in design, but based on one or other of these types. Magneto-electricity is applied for some forms of apparatus, and dynamo-machines are occasionally utilized to supplement batteries. The various terms, electro-motive force, resistance, induction and current, though measurable in definite units, have not yet become household words; but having been admitted into commercial, legal and parliamentary lore, they will soon be as familiar as feet, gallons or pounds.

Electric currents are conveyed from place to place either overground, underground or submarine.

*Overground.*—Wooden poles, preserved in creosote, are employed in England, but iron poles are extensively used in the Colonies. The conducting wire is almost universally of iron, but copper wire is much used through smoky places, where iron is liable to rapid decay. Phosphor-bronze wire is under trial, and is a very promising material, as it possesses the conductivity of copper with the strength of iron. The improvements made in the quality of iron wire have been very great, and it conducts now fully 50 per cent. better than it did a few years ago. Electric tests have had a marvelous effect upon the production of pure metallic conductors. Copper has improved in a greater ratio than iron, and samples have been produced better even than the standard of purity. The insulators remain principally of porcelain, and their forms vary nearly with the number of individuals who use them. The only improvement of any value recently made is one which facilitates the very necessary process of cleansing.

*Underground.*—Wires are almost invariably carried underground through towns. Copper wire, insulated with gutta-percha, encased in iron pipes, is the material used. There are 12,000 miles of underground wire in the United Kingdom. There is a great outcry for more underground work in England, owing to the destruction to open lines by gales and snow-storms; but underground telegraphs, wire for wire, cost at present about four times as much as overground lines, and their capacity for the conveyance of messages is only one-fourth; so that overground are, commercially, sixteen times better than underground wires. To lay the whole of the Post-Office system underground would mean an expenditure of about £20,000,000. Hence there is no desire to put wires underground except in towns. Besides, snow-storms are few and far between, and their effects are much exaggerated. Of the numerous materials and compounds that have been resorted to for insulating purposes, gutta-percha remains the oldest and the best for underground purposes. It, like all other materials used for telegraphy, has been improved vastly through the searching power that the current gives the engineer.

*Submarine.*—The past ten years has seen the globe covered with a network of cables. Submarine telegraphs have become a solid property. They are laid with facility and recovered with certainty, even in the deepest oceans. Thanks to such expeditions as that of H. M. S. Challenger, the floor of the ocean is becoming more familiar than the surface of many continents. There are at present 80,000 miles of cable at work, and £30,000,000 have been embarked in their establishment. A fleet of twenty-nine ships is employed in laying, watching, and repairing the cables. The Atlantic is spanned by nine cables in working order. The type of cable has been but very little varied from the first made and laid between Dover and Calais; but the character of the materials, the quality of the copper and the gutta-percha, the breaking strain of the homogeneous iron wire, which has reached ninety tons to the square inch, and the machinery for laying have received such great advances, that the Telegraph Construction and Maintenance Company laid a cable across the Atlantic last year in twelve days without a hitch or stoppage.

Ideas are conveyed to the mind by electric signals, and in telegraphy these signals are produced at distant places by two simple electrical effects: (1) that a magnetic needle tends to place itself at right-angles to a wire when an electric current passes through it; and (2) that a piece of iron becomes a magnet when a current of electricity circulates around it. An innumerable quantity of tunes can be played on these two strings. Various companies were established at different times to work certain systems, but when the telegraphs were absorbed by the State the fittest were selected to survive, and their number consequently declined.

The A B C instrument is the simplest to read, for it indicates the letters of the alphabet by causing a pointer to dwell opposite the desired letter. There are 4,398 in use. Its mechanism is, however, complicated and expensive, and it is being rapidly supplanted by the telephone. The needle instrument is the simplest in construction, but it requires training to work it. There are 3,791 employed by the Post-Office, and 15,702 among different railway companies. The Morse instrument, of which the Post-Office possesses 1,330, records its letters in ink, in dots and dashes, on paper tape, and, like the needle and A B C, appeals to the consciousness through the eye; it also indicates the letters of the alphabet by sound, and thus utilizes the organ of hearing. Sound-reading is gaining ground in England with great rapidity. There are now 2,000 sounders, while in 1869 there were none. In America scarcely any other instrument is used, but on the Continent of Europe there is scarcely one.

Acoustic reading attains great perfection in Bright's bell instrument, where beats of different sound replace the dot and dash of the Morse alphabet. Sound-reading is more rapid and more accurate than any system of visual signals or permanent record. The Hughes type-instrument, which prints messages in bold Roman characters, is much used on the Continent; it is, in fact, recognized as the international instrument, but it has had to give way in England to a more rapid system of telegraphy. It is, however, solely employed for the Continental circuits by the Submarine Telegraph Company. All long cables are worked by Sir William Thomson's beautiful Siphon-Recorder.

In ordinary working, only one message can be sent in one direction at one time; but by a simple and ingenious contrivance, by which the neutrality of opposite currents is utilized to convey signals, duplex telegraphy is rendered possible, so that two messages can be sent on the same wire at the same time; and by a still further improvement, where currents of different strength are utilized, four messages are sent on one wire—two simultaneously in opposite directions—at the same time. There are in England 319 duplex and 13 quadruplex circuits at work.

The acme of efficiency in telegraphy is attained in the automatic system, in which manual labor is supplanted by mechanism in transmitting the messages. There are 71 circuits worked by these instruments, and 224 instruments in use, and a speed of working of 200 words per minute is easily maintained upon them. With the hand alone from 30 to 40 words per minute is the maximum rate attained, but by automatic means the limit is scarcely known. Since this system can be duplexed, and in many cases is so, 400 words per minute on one wire are easily sent. By the use of high speed repeaters, the length of circuit for automatic working is scarcely limited. It would be easy to send 100 words per minute to India.

The growth of business since the telegraphs have been acquired by the State is enormous. 126,000 messages per week have grown to an average of 603,000; but the mileage of wire has not increased in anything like the same proportion, the excess of traffic having been provided for by the great improvements made in the working capacity of the apparatus. In 1873 the average number of messages per mile of wire was 147; it is now 256. It is in press work that the greatest increase has taken place. 5,000 words per day at the time of the companies have grown to 934,154 words per day now. 340,966,344 words of press matter were delivered in the year ending 31st March, 1882.

The development of railways has necessitated a corresponding increase in the telegraphs required to insure the safety of the traveling public; and, while 27,000 miles of wire in England, Scotland and Wales were used for that purpose in 1869, at the end of December, 1882, the total had increased to 69,000 miles, equipped with 15,702 instruments, against 4,423 in 1869.

The growth of business is equally discernible in the great cable companies. In 1871 the number of messages dealt with by the Eastern Telegraph Company was 186,000; in 1881 it was 720,000. This growth is equally striking in all civilized countries, and even in Japan 2,223,214 messages were despatched, of which 98 per cent. were in the native tongue.

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At Tuft's College, near Boston, a new course in electrical engineering has been established. The course is under the supervision of Prof. A. E. Dolbear, one of the pioneers of the telephone, and eminent for his electrical inventions. This department embraces instruction in wood and metal work at the vice and lathe, practice in running the steam engine, and an extensive experimental course, with electric and acoustic apparatus, with special reference to the application of telegraphy, telephony, and electric lighting.

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It is now proved to be possible to convey by means of electricity vibrations of light—to not only speak with your distant friend, but to actually see him. The electroscope—the name of the instrument which has enabled us to do this—was the very latest scientific discovery, and to Dr. Gnidrah, of Victoria, belonged the proud distinction. The trial of this wonderful instrument took place at Melbourne on the 31st of October last in the presence of some forty scientific and public men, and was a great success. Sitting in a dark room, they saw projected on a large disk of white burnished metal the race-course at Flemington with its myriad hosts of active beings. Each minute detail stood out with perfect fidelity to the original, and as they looked at the wonderful picture through binocular glasses, it was difficult to imagine that they were not actually on the course itself, and moving among those whose actions they could so completely scan.

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A series of experiments were made recently in the office of the Postal Telegraph Company, No. 49 Broadway, with Lockwood & Bartlett's new molecular telephone. The telephone was connected with a wire of the Postal Telegraph Company, running from this city to Cleveland, a distance of 650 miles, and over this wire conversation was held with Dr. Henry E. Waite, an electrician, and one of the inventors, who was stationed in the office at Cleveland. Among the gentlemen who tested the telephone were A. W. Beard, President, and H. Cummins, Vice-President, of the Postal Telegraph Company; A. D. Swan, President of the Molecular Telephone Company of New England; William S. Knox, of Boston; Charles F. Livermore, President of the Molecular Telephone Company of New York; J. J. Waterbury, under whose supervision the tests were made; R. T. Wilson, George S Coe, James O. Sheldon, George Bell, C. P. Dixon, James M. Johnson, W. F. Buckley and Geo. D. Roberts. The Bell receiver and also three or four other styles of instruments were tried. All worked equally well over the line, which is of copper wire. (See description in our last edition, March 22d, article on the Postal Telegraph Company.)

The molecular telephone differs from some others in the substitution of molecular action for mechanical vibration in the transmission of sound. The transmitter of the telephone, instead of being a metallic vibrating plate, is a carbon microphone, imbedded in and completely covered by cork, although wood, card-board, or any non-resonant material can be used. The receiver is a magnet surrounded by insulated wire at one of its poles, a continuation of which is made to tap against a plate of cork or any other substance that is free from inductive action by the variations of the current, its operation being similar to that of the sounders which are so extensively used in telegraphy. The cork absorbs the sound waves, thus producing within its substance molecular disturbance, by means of which the words spoken at the transmitting end are reproduced in a distinct manner without any confusion of syllables or liability to error in words in which sibillations occur. The molecular action ceases by the absorption of the sound waves as soon as the words transmitted are reproduced, and this, without reaction, produces articulation.

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A certificate of incorporation of the New York Mutual Telegraph Company has been filed. The incorporators are Wilson Godfrey, J. H. Walker, Wm. Yorke Attlee, George L. Record, and David B. Waters. The capital stock is $25,000, in 1,000 shares at $25 each. The capital may be increased by a vote of three-fourths of the stock. The line is to run generally from the Stock Exchange of New York, through New York, Pennsylvania, Ohio, Indiana and Illinois, reaching Chicago by way of Albany, Rochester, Cleveland and intermediate points.

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## The New Telegraph Company.

President Sidney F. Shelbourne, Algernon S. Sullivan, and Judge Henry A. Gildersleeve, of the New York Electric Lines Company, called on Mayor Edison recently and asked him to sign the franchise giving the company the right to tear up the city streets to place telegraph wires underground. This is the franchise which was rushed through the Board of Aldermen last week against the protest of two members without any explanation or information as to who were concerned in the company or its responsibility. The visitors told the Mayor that their colleagues in the company were Messrs. Edward A. Quintard, General James Jourdan, Edward Barr, Thomas L. James, H. H. Gorringe, George L. Weed, George S. Hart, Felix Campbell, and John H. Flagler. President Sheldburne spoke of the great benefit the city would enjoy if all the telegraph wires were put underground and the unsightly poles removed, and expressed his firm conviction that the ordinance giving the franchise ought to be signed by the Mayor. Alderman Wells, who protested against the passage of the franchise in the Common Council, urged the Mayor to withhold his signature. The franchise, he said, was put through the Common Council with improper haste, and the company was given a very valuable franchise for a compensation altogether too small. Mayor Edson said he would give the matter his careful attention, and the Electric Lines Company's representatives walked out.

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Articles incorporating the Mexican Peninsular Telegraph and Telephone Company were filed on the 14th inst. in the County Clerk's office in this city. The capital stock of the company is fixed at $500,000, divided into 50,000 shares of $10 each. The incorporators are Frederick M. Delano, Henry C. de Rivera and Charles Rabadon. These persons hold all the stock. The lines of the company are to run from New York across Staten Island to New Jersey and thence in as direct a line as possible to Yucatan, Tabasco, Chiapas and Oajaca, Mexico.

# Telephonic.

## What Major Lydecker and Capt. Greene, of the Corps of Engineers, U. S. A., have to Say About Placing the Wires Underground.

IT IS PERFECTLY FEASIBLE TO PUT MOST OF THEM UNDERGROUND, AT LEAST SO SAYS CAPTAIN V. F. GREENE AFTER CAREFUL INVESTIGATION — THE TELEGRAPH, ELECTRIC LIGHT, AND TELEPHONE TRUNK LINES CAN BE SO DISPOSED OF—THE REPORT FULLY INDORSED BY MAJ. LYDECKER.

The authorities of this, as well as other cities, have given the question of disposing of telegraph wires in some way so as not to offend the sight, endanger life, or interrupt the business of the companies, a good deal of study of late years. Some weeks ago the Engineer Department sent Capt. F. V. Greene to New York and other cities to make investigation, and report as to whether or not it were possible to put the wires underground. His report, which is a very comprehensive one, is given in full below:

OFFICE OF THE ENGINEER COMMISSIONER, WASHINGTON, D. C., March 15.—MAJOR G. J. LYDECKER, CORPS OF ENGINEERS, U. S. A., ENGINEER COMMISSIONER, D. C.—*Major:* In compliance with your orders, I visited the cities of Boston and New York between February 26 and March 3 for the purpose of examining the underground system of electric wires as actually in use in those cities, and I have the honor to submit the following report of my observations:

In Boston the telegraph and electric light wires are still carried overhead. In the thickly-settled business parts of the city, within half a mile of the City Hall, there are no poles, because the sidewalks are narrow and underlaid with a continuous line of vaults, which make the pole system practically impracticable. The wires are, therefore, carried on fixtures secured to the roofs of houses. The telephone wires have also been carried in the same manner until recently, but in consequence of the accumulation of these wires near the Central Office, and the risk of their total destruction during a storm, the telephone company has lately undertaken an experiment with the underground system, intending to apply it to all their trunk lines in the principal part of the city if it prove successful.

The Central Office of the telephone company is at Franklin and Pearl streets. From this point one line of overhead fixtures, carrying nearly 800 wires—520 single wires and 280 conductors in cables—runs to State and Congress streets; another line of fixtures, carrying about 500 wires, partly single wires and partly in cables, runs to Franklin and Washington streets. From the latter points both systems diverge to various sections of the city. The object of the experiment is to put these two main trunk lines underground. For this purpose the company has adopted its own plans without reference to any of the numerous patented systems. The plan, in brief, was to lay three-inch boiler tubes in cement about four feet underground, and to draw into the tubes the ordinary cables of fifty conductors each in use on their overhead lines. A manhole was built at each intersecting street, and covered with a double cover in order to insure the complete exclusion of moisture, which is absolutely essential to the success of any underground system. Drawings of the conduit and manholes thus constructed are submitted herewith.

The Pearl street conduit consists of eight tubes and the Franklin street of six tubes to Devonshire street and four to Washington street. Each tube can carry three 50-conductor cables. The number of cables actually drawn in at present is one "western electric" on Franklin street and three "western electric," one "Day," and one "Phillips" on Pearl street. These cables will be subsequently described.

The work of constructing the conduits was begun October 16, and finished November 17, 1882. The total length is 2,650 feet, containing 17,000 feet of tubes. The total cost was $14,296.26, or about 84 cents per foot for one tube with capacity for one hundred and fifty conductors. This is exclusive of the cost of cables.

The connection at terminal points between the underground and overhead wires is made as follows: At the Central Office insulated wires run from the switch-board to a connection box, where they are jointed to the projecting ends of the conductors of each cable. The cables are then carried down the walls of the building to the cellar, and thence under the street to the manhole, where they enter the tubes of the conduit. At the other end the cables are brought up from the manhole along the outside of the wall of a large building to its roof, where there is a similar connection box containing the joints of the ends of cable conductors and the single wires of the overhead system.

These connections were being made while I was there; and as soon as completed it was intended to put the underground line in use. Its feasibility is, however, not in doubt, as cables of this description have been in use for some time on the overhead fixtures, and they were very fully tried in an experimental line laid along the track of the New York and New England Railway about a year ago.

The experiment in Boston is therefore merely for the relief of a trunk line which had become so overloaded as to be in danger of destruction overhead. It offers no solution of the problem of an underground system for house connections similar to a system of gas and water mains and services. The removal of the trunk lines, however, is of immense service, and no doubt is entertained of the success of this. The principal electrical difficulties are those arising from induction and retardation. The former is completely overcome in the cables referred to. One of them employs a metallic circuit—the two wires being insulated and wrapped around each other in a gradual spiral, and it is found that the simultaneous current in both wires breaks up the inducted currents. Another cable uses the ground circuit, the single wire being insulated with india-rubber and then covered with a thin coating of tinfoil—forming, in fact, a Leyden jar. The inducted currents are then wholly in the outer coating, where they are harmless.

In overcoming induction, however, another difficulty is created in retardation. Each time that the current is made and broken the electrical condition of the insulator is changed; in other words, the jar is charged and discharged. This consumes a small but appreciable amount of time, and causes the well-known delay in transmitting cable messages.

The amount of retardation depends on the length of cable. With the telephone the current is made and broken several thousand times in a minute, and when the full length of line is such that the retardation is equal to the interval between the sounds, the latter become confused and the telephone is useless Practical experience has shown that with all the cables experimented upon in Boston this occurs when the cable has a length of two miles, and this is therefore the limit of direct use of the telephone with such cables. Whether some other device of conductors and insulutors will be invented which will give less retardation, and thus increase this limit, it is impossible to say.

The system in Boston is therefore perfectly applicable to trunk lines for telephone wires within a length of two miles. It is, however, very costly. For a mile of 150 conductors the cost, based on Boston prices, would be in round numbers $20,000, whereas the same length of line for the same number of conductors on fixtures overhead would cost only about $3,000. The three cables previously referred to are the "Western Electric," "Day," and "Phillips."

The Western Electric is manufactured in Chicago, and consists of 100 wires of No. 22 copper, forming fifty conductors with metallic circuit. Each wire is covered with fine cotton tape, and wound spirally in sets of two wires. The fifty conductors are then placed in a lead pipe, and this is filled under pressure with hot parafine and resin, which is boiled in the pipe so as to fill the interstices of the tape and form a complete insulation. The external diameter of the pipe is one and one-eighth inches.

The Day cable consists of forty-three conductors of small copper wire. Each wire is insulated with kerite, rubbed with plumbago. Seven conductors are coiled in the center, forming a core which is covered with tinfoil. Two layers of other wires are then wrapped spirally around this core, the first layer to the right and the second to the left. The exterior is covered with tinfoil and then wrapped with two thicknesses of rubber cloth as an outer protection. The external diameter of cable is one and a half inches.

The Phillips cable has thirty-eight conductors of small copper wires, each wire being insulated with india-rubber and surrounded with tinfoil forming a Leyden jar. The external protection is braided cotton prepared and painted. Diameter, one and a quarter inches.

Such cables as these are necessarily very expensive. They are quoted at two cents per foot for each conductor, with a discount depending on the quantity of the order.

In New York, nearly all the wires are carried overhead, partly on fixtures attached to the roof and partly on poles. In certain districts the number of wires is so great that cables are used on the poles similar to those just described. The Western Union Company has, however, one line of underground cable, carrying about one hundred conductors, from its office on Broadway to the Hudson River, and another line from its office to the Stock Exchange. On the latter line this company has also a line of pneumatic tubes, which are found to be very serviceable and to dispense with the use of a number of wires. This company has also made contracts for the laying of another line of pneumatic tubes from its Central Office to the branch office at Twenty-third street and Broadway—a length of nearly three miles.

There will be four tubes of brass three inches in diameter. Two of them will form a circuit for through business and two of them for local business, with connections at intermediate offices. A constant current of air is maintained in these tubes by fans, which exhaust at one end of the tube and pump in at the other.

The messages are carried in small leather pouches at a velocity of about two miles a minute.

These tubes will do away with a large number of wires—probably as many as fifty. At the same time the company proposes to lay in the same trench a pipe carrying three hundred insulated wires, loosely coiled together in the form of cables. The insulation is gutta percha, and the price was stated at four cents per foot for each wire, which, if correct, seems to me to be altogether excessive, as compared with other forms of insulated wire.

The telephone wires are all carried overhead in New York at present, some of them as single wires and some in cables.

The electric light wires are also overhead, except in Edison's, "District No. 1." This is a district containing about one hundred and fifty acres, bounded by Wall, Spruce and Nassau streets, and the East River. In this district there are four thousand incandescent lights in use, and the electricity is supplied entirely by underground pipes. The system is extremely simple and successful. It is fully described in Edison's and Kruesis's patents, Nos. 251, 252, and 266–483. Mains are laid on both sides of the street, consisting of two-inch or three-inch wrought-iron pipes, carrying the two poles (copper bars) insulated in a compound of asphalt The pipes are in sections of twenty-five feet united in a junction box, which can be opened at any time in order to make the house connections. At each intersecting street there is a manhole, where the mains are brought together and put in electrical connection with a feeder (which is simply a large main) coming direct from the electrical machines in the Central Office. There are twenty such feeders, and in all twenty-one miles of mains and feeders, independent of the house connections.

This system is in complete and successful operation at the present time, and it constitutes an unanswerable argument to the plea that such a system is not feasible for electric lighting.

I did not visit Philadelphia, as there are no underground wires in use there at present. Negotiations are in progress looking to the introduction of the Brooks system in that city. This is fully described in the letters patent, and consists essentially of wires covered with tape, placed in a pipe filled with parafine oil. Until this system is fully tried it is not necessary to discuss its probable merits and defects. I submit herewith several printed documents giving the opinions of experts concerning the underground system.

The experiments now in progress in New York and Boston, and the long use of underground wires in London and other cities in Europe, prove incontestably that the underground system is perfectly feasible for trunk lines. Its first cost is greater than that of the pole system, but the immunity from storms and other overhead dangers may possibly make it cheaper in the end. At all events, the expense is not beyond the means of the companies. There are several systems in actual use, and an immense number of proposed systems, covered by letters patent, some of which appear to have merit and some have none. It is for the companies interested to determine by experiments which is the best. The electric light wires, the telegraph wires, and the trunk lines of the telephone can all be carried underground with perfect success. The distribution of the telephone wires to separate houses in an underground system is attended with difficulties, which as yet have not been overcome. This, however, need give no inconvenience in this city, for a single pipe can be led to the alley in the center of each square, which will carry all the conductors needed for that square. They can be drawn into the pipe as needed, and can leave it in the alley and be carried up a pole for distribution to the rear of the houses where needed. There would be no objection to single wires in the alleys and back yards of houses.

I recommend, therefore, that the commissioners pass an order prohibiting the further erection of any poles whatsoever on the public streets for carrying electric wires, provided that such poles as may be necessary for distributing telephone wires may be erected in the alleys.

Also that certain experiments be made on the fire alarm wires to test an underground system less expensive than those now in use; that estimates be submitted to Congress next fall for placing all the fire-alarm wires underground, and that a special report be made to Congress, and plans of the underground routes proposed for the different companies in this city, and the draft of a bill to compel the removal of the overhead wires at an early date.

Very respectfully,
F. V. GREENE,
Captain of Engineers, U. S. A.

INDORSEMENT OF MAJOR LYDECKER.

The valuable information supplied by Captain Greene in this report is the result of investigations made during the inspection trip to which he was recently ordered, and for which he had previously prepared himself by careful study of existing publications. The report furnishes important data for the guidance of the commissioners in their future action concerning the disposition to be made of electric wires, and affords them ample warrant for sounding the death knell of the overhead system in this city. It is conclusively shown that the underground system is perfectly feasible for all telegraph and electric light wires, and for the trunks of telephone lines, without imposing on the companies any burden that the public interests may not reasonably demand. These conclusions are not based on theory and experiment only, but result from intelligent observation of systems in actual and successful operation.

I concur in the opinions, and urge the adoption of the steps recommended herein.

G. J. LYDECKER,
Major of Engineers, U. S. A., Engineer Commissioner District of Columbia.

## The Northwestern Telephone Company.

The telephone, like the electric telegraph, the steamboat and railroad, is no longer to be looked upon as an experiment, but as a fact of the greatest importance to the people of a progressive age like the present, when the principal desideratum is money. Hence it is that a few of New England's brave spirits launched out upon what at its inception seemed to be a sea of uncertainty in providing the public with this unwonted convenience, but these far-seeing individuals, prompted by the courage of their convictions, went forward, measuring their steps carefully, and as a result success has attended their efforts, fortune has smiled upon their pathway, the world is being benefitted by them, and the telephone has become one of the greatest successes of the nineteenth century. This enterprise has no limit, as its field is universal, and with every succeeding day its electric arteries are becoming more extended, and the day is not far distant when the telephone will be common to the civilized world.

The public is familiar with the various steps by which our city has acquired so much importance as a telephone center, and to some extent with the particulars of the latest acquirement in this direction, by which a Lowell syndicate has purchased the territory and all the rights hitherto owned by the "Northwestern Telephone Company."

President Ingham, of the local company, and A. A. Coburn, one of the Board of Directors, who were delegated with full power by the syndicate to make the purchase, returned from their business trip to Minneapolis, Minn., last Saturday, with the most encouraging reports relating to their purchase, characterizing it as the most promising ever made by the company.

The territory purchased, as has been stated heretofore, includes the entire State of Minnesota; Burnett, Douglass, Pierce, Polk, and St. Croix Counties in Wisconsin, and a very large portion of Dakota (in general terms, that portion north of the forty-sixth parallel). This extensive territory affords an unlimited field of action, and with the push of enterprising New Englanders back of it, success is certain. The principal exchanges will be located in St. Paul, Minneapolis, Stillwater, Winona, and two other cities. The amount of the capital stock of the company has not yet been decided upon, but it will probably be about $650,000, with $100,000 in the treasury for use during the coming summer in extending the lines and making general improvement in the service.

General Manager Downs, of this city, and ex-Superintendent Temple, of Salem, left Tuesday evening for the new field of action, where Mr. Temple will serve in the capacity of local superintendent. All stock meetings will be held in this city. There are at present upwards of 1,400 subscribers, and the applications are increasing almost beyond the possibility of supply. The January earnings exceed 8 per cent. on dividend-earning capital of $550,000, and it is asserted upon good authority that it will pay 6 per cent. on $1,000,000. The stock, as is known, was recently put upon the market, and to show the almost unprecedented confidence of the public in the wisdom of the purchase, it might be stated that the shares were nearly all taken before the return of the purchasers last Saturday, the transaction having taken place only the week before. The contract with the American Bell is one of the most liberal, and expires at the end of five years, but no agency can be established in any part of the Northwestern territory at any time without the consent of the company. It has not been decided whether it will be advantageous to make a perpetual contract, but the investment has been made secure in all essential particulars.

As has already been said the condition of the service was bad, and Messrs. Ingham and Coburn were astonished to find, on their arrival in St. Paul and Minneapolis, the greatest business marts of the Far West, such a state of affairs. These cities are situated only ten miles apart, and are only connected by twelve wires, and Stillwater, another thriving city, thirty miles distant, has communication with Minneapolis through only one wire. In St. Paul the poles of the principal line are eighty feet high and carry 110 wires, but in neither St. Paul nor Minneapolis is the telephone utilized in dwelling houses, except in a very few instances, and private lines are principally in use.

Owing to the close relationship between these great centers, it will readily be seen that a vast improvement can be made, and it is possible that one of the first moves by the new management will be to run a cable between the two cities carrying fifty wires; also to make the service so complete that business men cannot fail to see and avail themselves of advantages it will afford them. It has been estimated that the population of Minneapolis increased nearly 20,000 during the past year, and it is prophesied that the increase of the two cities during the current year will be as much as 35,000. The present service in those cities is very similar to the condition of telephone affairs in the suburban towns in the vicinity of Boston something over a year ago. Minneapolis stands in the same relation to the West to-day that Chicago did before Minneapolis began to be. There can be no retrograde movement in the progress of this great city, as it has already become one of the world's great centers. It has at present a capacity for grinding 25,000 barrels of wheat per day, the Northern Pacific Railway Company are erecting mammoth car shops within its limits, and in fact everything points towards unlimited progress, and it is certainly fair to presume that the telephone under the direction of Yankee enterprise and genius will be contemporaneous with its growth in other departments. The present condition of telephone matters in that section of the world is owing to the lack of experience. When Messrs. Ingham and Coburn arrived they found the central offices poorly fitted up, the operators were lax in giving service, the people consequently indifferent, never having had or known the true merits of this valuable instrument; but the presence of these gentlemen in their official capacity served to wake the people up, and when the operators had shaken off their lethargy, those who had lines received good service, and seemed to appreciate more fully the advantages afforded by the telephone.—*Ex.*

## A New Invention.

The latest idea in the way of preventing the abuse of the telephone by non-subscribers is that of the photograph. The arrangement is such that when any one calls the exchange there is exposed to the view of the operator an instantaneous photograph of the person calling. This photograph becomes a record, each ribbon on which they are displayed being capable of producing, when brought into action, 250 photographs. According to a system devised, these ribbons are checked up, and the subscriber is charged so much for each person using not entitled to its use.

To the subscriber this will afford a great relief, in that the exchanges will give them a better service, as the telephone is supposed to be solely for the use of the party paying for it, and not for those who do not possess one. This invention is looked upon as being a way out of the serious annoyances arising from the inordinate demands on the service by those who are not claimants for good work, as by reducing them to a minimum the cost is lessened and the service is heightened. Provision always will be made for those who want to pay for telephonic communication.

A number of leading citizens of Van Wert have organized the Edison Telegraph Company, to build a line along the Cincinnati, Van Wert & Michigan road, which at present runs from Greenville to Paulding, O. Major E. C. Dawes was elected president; H. P. McGovern, vice-president; W. H. McCann, treasurer; J. P. Shissler, secretary. Besides the above gentlemen, the following compose the board of directors: Col. J. McMarble, J. P. Gasse, and H. Van Tilberg.

## Seeking the removal of the telegraph poles from Twenty-first Street.

The suit of the people against the Metropolitan Telegraph and Telephone Company is on trial for the second time before Judge Barrett and a jury, in the Supreme Court. The jury disagreed on the first trial, which took place before Judge Lawrence. The purpose of the suit is to compel the defendant corporation to remove from Twenty-first street, between Fifth and Sixth avenues, a number of large poles or masts which it has erected there for the carriage of its wires and cables, and which, it is alleged, interfere with the public use of the street. The Metropolitan Telegraph and Telephone Company was organized under the General Telegraph act of 1848, as amended in 1853, which provides that corporations having their being through it are authorized to erect and construct their necessary fixtures "over, under, or upon" any street or avenue, but they shall not incommode the public use of such street or avenue. When the general telegraph act was passed and amended the poles in use were small and had to support but few wires. With the increase of the telegraph business the poles became taller and of greater girth, and the wires grew in number. In 1879 the poles averaged 35 feet in height and 9 inches in diameter. The Metropolitan Telegraph and Telephone Co. erected poles surpassing all others in size, their average height being 60 feet, and their average diameter 20 inches. On them are strung cables whose strands are made up of from 30 to 105 wires. They are poles and cables of this calibre that the people object to in West Twenty-first street.

The people are represented in the trial of this suit by Messrs. L. E. Chittenden and De Lancey Nicoll. Mr. Burton N. Harrison appears for the defendant company. At the opening of the trial Messrs. Chittenden and Nicoll advanced the proposition that a corporation provided by law with alternative methods of doing the work which it was organized to do was bound to take that means which would be least injurious to the public. Judge Barrett ruled that the defendant corporation had an absolute right to erect poles and string wires in Twenty-first street; that the people could not direct their evidence toward proving that the poles used were unnecessarily large; and that the only question for determination was as to whether the poles interfered with the public use of the street or not. A number of witnesses were examined, who testified that the girth of the poles was so great as to obstruct rays of light from the gas lamps, and thus to obscure portions of the street; that they took up part of the sidewalk needed by foot passengers; and that they and the wires supported by them presented great difficulties to the Fire Department. After all this evidence had been put in, Judge Barrett said he would dismiss the complaint, but that he would have allowed the case to go to the jury if the plaintiffs had shown that the poles were unnecessarily large. The fact was then called to his mind that he had excluded such testimony, and that the people had been prepared to present it. He therefore reopened the case, and the plaintiffs presented several experts in the construction of telegraph lines, who testified that the poles were unnecessarily large.

The principal witness for the defense was Mr. Amzi Dodd, Treasurer of the Metropolitan Telegraph and Telephone Company, who testified that the poles were necessary for the business of the company. Mr. Chittenden asked him, on cross-examination, what was the business of his company. The question was objected to by Mr. Harrison, but Judge Barrett admitted it, after hearing a long argument, on the ground that if the people could show that the poles and wires were not for public use, but only for the use of subscribers or regular customers of the company, it was a fraud in law. Mr. Dodd answered that the company lets out its telephones, but that a non-subscriber may use one of them by going to a District Messenger office, from where he can communicate with a subscriber, or if he desires can call for a messenger to go from a distant office to the house or office of another non-subscriber with a message. In this way, he said, any person could save time, for if the telephone was not at hand he would be compelled to send a messenger the entire distance. The trial will be continued to-morrow, and evidence will be presented by the plaintiffs to show that only subscribers are allowed to use the telephones of the defendant in District Messenger offices, and that a non-subscriber will not be allowed to telephone to a District office for a messenger to go a short distance from it, but must send one all the way at increased cost and unnecessary expenditure of time.

### A JURY DECIDES AGAINST THE POLES RAISED IN TWENTY-FIRST STREET.

A jury in the Supreme Court have decided that the poles erected by the Metropolitan Telegraph and Telephone Company in Twenty-first street, between Fifth and Sixth avenues, are a nuisance to the public. In the suit in which this verdict was rendered the people of the State or New York are the plaintiffs. The grounds of the suit were, originally, that the Metropolitan Telegraph and Telephone Company had improperly erected poles and strung wires above the street, when it could have laid the wires underneath the street, and thus have avoided giving inconvenience to the public; that the poles were larger than necessary, and that even if they were not too large their mere presence in the street incommoded the public in its use. Judge Barrett ruled that the defendant company had an absolute right to erect poles in the street, and he confined the plaintiffs' testimony to the proof of the allegation that the poles were larger than necessary, and were, therefore, a means of incommoding the public. In the course of the trial the plaintiffs proposed to show that enormous masts could not be necessary for the business of the defendant company, because, by an alleged agreement between it, the Western Union Telegraph and the District Messenger Telegraph Companies, that business was restricted to performing services for its subscribers, about 3,000 in number, to the exclusion of other persons who may from time to time desire or need to use telephones. Judge Barrett ruled out the proposed testimony.

While charging the jury Judge Barrett said:

"There is no averment in the complaint that the nuisance complained of consists of the erecting of a structure for the conduct of a private business, and, consequently, it does not come within the law. On the contrary, the complaint simply avers that this defendant is a corporation, and that it has erected a structure for the conduct of its business which is objectionable in certain particulars, which are specified. It seems that, in the course of the trial, in the cross-examination of the witnesses, certain facts have been developed tending to show that the use of these telephones is limited to the subscribers, and from that the learned counsel argues that the business is not a public but a private business, and that, under the pretense of doing a public business under a proper charter, the defendant is usurping the franchise of doing a private business not contemplated by the law."

Recent experiments by Prof. Kohlrausch, of Germany, lead him to the result that silver chloride, bromide, and iodide conduct electricity at temperatures above their melting points much better than the best conducting sulphuric acid, that is, the best-conducting liquid conductor at ordinary temperature. The chloride conducts best, the bromide comes next, then the iodide. The resistance of silver chloride and bromide increases very much and quickly in solidification of the substances, and on cooling to 20° it rises to more than a million times the initial value. Iodide of silver, on the other hand, does not alter in resistance in solidifying, but first shows a rapid increase of resistance at 145°, the temperature at which it passes from the amorphous into the crystalline state.

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## Recent Experiments With the Telephone on Long Lines.

It has scarcely been possible to take up a daily newspaper during the past week without falling foul of some article, item, or comment upon the wonderful novelty in telephonic instruments by which articulate conversation has been transmitted and reproduced between New York and Cleveland, O., a distance of 650 miles by wire.

It is somewhat curious to note the different opinions and different statements which are given on this subject. For example; the *Scientific American* for March 17, 1883, gives a graphic account of such a telephonic feat as accomplished by the use of the Hopkin's Transmitter, the peculiarity of which is, that the normal or initial pressure between the electrodes is obtained by floating one of them in mercury; this serving to press them together without the use of a spring.

The *Operator and Electrical World* referring to the same subject, speaks of the accomplishment of telephonic communication between New York and Cleveland by means of the Dorrance telephone, whatever that may be.

The Baxter telephone is also referred to, and this is the instrument which has been most widely advertised in this connection.

As a matter of fact, when the conditions are taken into consideration, there is very little of the extraordinary in the above experiments. It must not be forgotten that the linewire employed was such a one, as has never, until now, been constructed; a wire that on its last resistance measurements measured but 1½ ohm per mile, and that for its size and conductivity has a very low electrostatic capacity.

By the use of such a wire we have no hesitation in saying that conversation could be readily carried on between the two terminal points using an ordinary Bell magneto telephone, as a transmitting instrument. Neither must it be forgotten that no switchboard intervened between the talking parties at both ends of the line, and that above all, no short subscribers' lines were hitched on at both ends, with a central office operator stationed at the junction point, and a well-meaning but plot-marring subscriber at the end of each short line.

Experimentally, we can do almost anything, but doing it experimentally and commercially are very different things. We are reminded of the old saying of Prof. Morse, who before he would consent to go into anything new, would satisfy himself not only that it was practicable, but also that it was practical.

The uniform success of all telephones which have been operated over this Cleveland line point, we imagine, to a sound moral, namely: that to communicate by telephone successfully over very long distances, the class of construction employed, and the character of the conductor, are elements fully as important as the instruments whereby the message is transmitted or reproduced.

## Electricity in the Light-House.

To France belongs the credit of having first discovered the advantages of lighting the coast with electricity. We have heard that electricity has a shorter range of visibility in thick or foggy weather than oil, but the experiments of the French engineers that have been made during the past ten years, together with the evidence of sailors who have approached the French coast since the use of the electric lights, refutes this in toto. On the contrary, it has been found that the electric light shows clear and steadily when the oil lamps, backed by their large and costly lenses of cut glass, are obscured.

Indeed the report of M. Quinette de Rochemont, *ingenieur des ponts et chausseés*, which is before us, contains the assertions of masters of vessels to the effect that through the agency of the electric light they have been enabled to enter harbors during thick and foggy weather, while formerly, when oil was used in the light-houses, they were unable to see their way.

In order that the lighting of coasts be efficient, it should be continuous, so that a vessel while following the shore-line, as soon as it passes the range of one light should come within that of the next; in other words, that the circles of range should cut each other successively. This is true of the oil lights in clear weather, but in thick or foggy weather this is not the case, and a vessel losing one light might, before getting within the range of another, bring up on the shore.

Though the range of visibility of electric lights in foggy weather is far greater than that of oil lights, as has already been said, the cost of maintaining them is by no means excessive. Thus the annual expense of a first order oil-light is about $1,660; while for each electric light-house at la Hève, for instance, the cost is $2,270, and for that of Cape Griz-Nez $2,680. Comparing the cost of a unit of light for a light-house lit by oil with one lit by electricity, we find that the former costs $81 per unit, while the latter costs $22 at Cape Griz-Nez, and $19.40 at la Hève.

## A Hint to the Gas Companies.

We would commend to the attention of the gas companies one feature especially of the Electrical Exhibition now being held at the Westminster Aquarium, London. It consists of a practical exposition of the greater value of gas as fuel for a dynamo machine than as an illuminant. A small gas engine is made to work a dynamo of sufficient power to generate electricity for the complete lighting of a country dwelling.

In another part of the hall, where the exhibition is held, two chambers have been constructed—one lighted by gas and the other by electricity. A thermometer placed in each registers their respective temperatures. This is an important feature, for the increase in the temperature of a chamber in warm weather by the use of gas adds not a little to the discomfort of whosoever inhabits it, and the tests that are soon to be made of the amount of sulphurous fumes and noxious odors thrown off by the gas will go far toward proving conclusively both to country and city folk the advantages of electricity as an illuminant, as compared to the product of coal.

Arc and incandescent lights of many descriptions are placed side by side throughout the vast building, and the public is given a rare opportunity to observe for itself the advantages of one electric system over another, as well as the superiority as an illuminant of electricity to gas.

## Telephoning from Here to Chicago.

The Postal Telegraph Company on Saturday last opened its line for private test between New York and Chicago, and everything worked perfectly. The resistance of the wire showed only 1,522 ohms, as against 6,000 ohms on the best iron wire, and 15,000 ohms on the average iron wire. Prof. Elisha Gray and H. Cummins, Vice-President and general manager of the Postal Telegraph Company, conversed freely and distinctly with Mr. Taylor, the company's electrician in Chicago, a distance of 1,000 miles.

The stocks of the western telephone companies are commanding top figures now. The youngest of them, the Missouri & Kansas Telephone Co., sold a day or two since at a large advance, and is still going higher.

The City & Suburban Telegraph Co., of Cincinnati, it is estimated, lost, in actual damage to wires, poles, instruments and service, $20,000 during the recent flood there.

The Western Electric Co., of Chicago, Indianapolis and New York, are erecting in Chicago a new factory, which will be ready for occupancy by August. It will be the largest of the kind in the world, the one now occupied being entirely too small for their already extensive and constantly increasing business.

The New Jersey Telephone Co., recently organized at Freehold, has commenced the building of a telephone line from here to Freehold, taking in the towns of Red Bank, Seabright, Eatontown, Shrewsbury, Asbury Park, Keyport, and South Amboy. When completed, this line will make direct communication with New York, Brooklyn, and Westchester County, New York State, and the whole northern portion of New Jersey, embracing a territory within 45 miles of New York City. All the summer hotels at Long Branch, Red Bank, Elberon, Seabright, Asbury Park, Ocean Grove, and Spring Lake will be in connection with this new telephone line.

The "New Gilliland Magneto Bell" is now coming out, and is a marvel of beauty, finish, strength and simplicity, having essentials long wished for.

The "Lowell Syndicate" bought a good territory when they made the purchase of Minnesota.

A Pittsburg girl who had refused a good-looking telegraph repair man three times within six months gave as a reason that he was too much of a wanderer; that he roamed from pole to pole, from one climb to another, and if he did come home, he'd be insulate that the neighbors would be sure to talk.

Though the press and the public are continually protesting against the present mode of executing criminals, viz., by strangulation—many of the suggestions made looking to a reform in this matter would result, were they carried out, in only lessening to a slight degree the brutality of the prescribed death penalty.

If the death of the condemned man is all that the law requires, I would suggest the use of electricity instead of the death-trap and the rope, and then, instead of reading the day after an execution that the rope gave way and the criminal, half strangled, was compelled to remain upon the platform of the gallows until another could be adjusted, we should be informed that the man passed from life to death instantaneously and without pain.

Mr. Lane-Fox in a recent number of the *Zoöphilist* describes a ready means of killing animals by electricity expeditiously and painlessly, and the same means might be employed in carrying out a death sentence in a civilized manner.

The Executive Committee of the International Fisheries Exhibition, England, have come to a decision to light their galleries with electricity, and they have already made arrangements for the illumination of fully two-thirds of the area. The motive power required will be nearly 700 horse power.

PHILADELPHIA, March 24.—The Common Council this afternoon passed an ordinance instructing the City Solicitor to bring suit upon the $20,000 bond of the Mutual Union Telegraph Company, and the Superintendent of the Police and Fire Alarm Telegraph to take possession of the wires and fixtures in this city. The suit will be based upon the consolidation of the Mutual Union and Western Union companies. The bond and privileges of the former company are forfeitable upon consolidation with any competing line.

Vice-President Henry Cummins, of the Postal Telegraph Company, of No. 49 Broadway, said Saturday:

"We are sending and receiving between New York and Cleveland 1,000 words per minute each way by the automatic system. Five messages are being sent to Cleveland and five from there simultaneously on a single wire by the harmonic system. We telephone to Cleveland as easily as we can across the street. The wires are now completed to Chicago, and we expect that they will be in working order next week. The present use of the wires is in the way of experiment, but they will be open for public business within a few weeks."

### Electricity and Ears.

On page 6 of the last issue of the REVIEW I notice an account of a floating paragraph which states that a person in Troy is troubled with a left ear of enormous size, owing to the fact that he has been in the habit of using that ear exclusively in connection with a telephone.

The paragraph goes on to state that Mr. W. H. Eckert was asked what he knew regarding the effect of electricity on ears, and characterized the story as preposterous and absurd, going on to give some of his own experience in the matter both in New York and Cincinnati.

It is almost a pity that the original veracious paragrapher started his story at such an incipient stage. He should, for the sake of uniformity, have permitted the slave of the telephone to keep on using his left ear until that useful aural appendage had attained the respectable and asinine length of about ten inches, after which a change to the exclusive use of the right ear would be in order until that also abandoned its dormancy and vied in altitude with its partner. Thr next step would naturally be a morbid attachment to Canada thistles as an article of diet, this symptom being closely followed by a frantic desire to attain a distinction in the practice of vocal music. Thus evolution would be vindicated and the manes of the lamented Darwin appeased.

It is true that such an extension of the malady is not to be looked for, which is somewhat of a misfortune; for if we could depend upon the development of the congenital members of the genus "equus asinus" in the manner we have indicated, many doubts regarding the lineage of certain persons would be eliminated, and we should be enabled to gauge their mental calibre with much greater facility and precision than heretofore.

Moreover, when we look at the matter seriously, we need have no hesitation in deciding that the development which we have imagined is at least as probable as that of our veracious paragrapher.

In other words, the entire statement is so ridiculous that it is not worth a serious thought, and can have no foundation in fact.

### Amalgamation of Telephone Companies of Milan.

(*Translated for the* REVIEW *from L'Electricité.*)

The character of public interest possessed by telephony, wherever it has been brought into general use, has generally imposed the necessity of consolidation of all the private enterprises undertaken to exploit this new branch of modern industry.

An example of this necessity, whence monopolies arise, has just been given in Milan, where two rival telephone companies which divided the telephonic business of the city, have been obliged by municipal interference to submit to a "marriage of convenience."

One was the *Société Générale Italienne des Téléphones*, whose systems cover all the important cities of Italy, and the other was formed by a local syndicate of bankers connected with the American Bell Telephone Company.

The *Bulletin de la Compagnie Internationale des Téléphones* informs us that, after having carried on a very severe competition, these two companies had connected between them about 1,000 subscribers during about eighteen months. But, in consequence of being divided into two groups, these subscribers could not obtain from their instruments all the advantages that they would be able to secure with a single service, and their complaints have been so vigorous of late that the Milanese municipality has felt the necessity for intervention The city has, therefore, ordered the two companies to arrange to join their systems and work in concord within three months, under pain of suffering a withdrawal of the municipal authorizations indispensable for their continued operations.

In view of this fact, which is likely to be reproduced in all populous cities, we must agree with our excellent contemporary, which sees in this municipal interference "an official indorsement of the principle of the necessity of the unification of telephone service, not only in cities, but even for whole countries."

The certificate of incorporation of the Telephonic Telegraph Company was filed in the County Clerk's office on Wednesday last. The object of the new company, as stated in this certificate, is to construct and use lines for telegraphic and telephonic purposes between this city and San Francisco, and this city and the cities of Quebec, Montreal, Hamilton and Toronto, Canada. Its capital is $100,000, divided into 1,000 shares, which are held as follows: Erastus Wiman, 332; Abner M. Rosebrugh, of Toronto, Canada, 332; George Black, of Hamilton, Canada, 332, and John Moss, John T. Kennedy, Hugh Morrow and William D. Wilson, each 1 share. The four last-named shareholders are the incorporators of the new company. Mr. Wiman is a member of the firm of Dun, Wiman & Co., and is largely interested in the Western Union Telegraph, Canadian Telegraph, Overland Telephone and other telegraph and telephone enterprises. George Black, of Hamilton, Canada, and Dr. Abner M. Rosebrugh, of Toronto, Canada, are both practical electricians, whose joint invention forms the basis for the organization of the new company. This invention is a device to be attached at terminal and intermediate points on a common telegraph wire, and which, it is claimed, destroys induction, so that the wire can be used simultaneously for telephonic and telegraphic uses. Wednesday, in the presence of a large number of experts, the device was tested on a wire that was being used for telegraphic purposes. The two parties testing the new device were situated, one at the office of the Overland Telephone Company, at No. 171 Broadway, and the other at Fourteenth street. The same messages were sent at the same time over the same wire strung on poles on which there were other wires, and the experimenters had no trouble in receiving or sending by either word of mouth or the Morse system of telegraphy. A similar experiment was tried recently on a line 40 miles long, extending from Hamilton to Toronto, Canada. This experiment was made while the ordinary telegraphic business was being transacted, and seven messages were telegraphed over the wire while the message was being telephonically transmitted. A party of expert electricians are to make a test of the invention on a line of the Merchants and Bankers' Telegraph Company between this city and Philadelphia. The use of this invention, it is claimed, so practically kills induction that telephonic service in large centers like this, where the electric contrivances supercharge the earth with electricity, can be greatly improved.

### Electrical Jottings.

Of all the electrical news coming from France, none is more interesting—save the experiments now making regarding the electrical transmission of power—than the bulletin of progress made by M. Gaston Tissandier.

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As all the world knows, this ingenious electrician is engaged upon the problem of ærial navigation by electricity; and a special report by a trusty correspondent assures us that his efforts are meeting with the most flattering success.

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Tissandier's idea is to furnish his machine with buoyancy by means of gas and a lateral movement by electricity. He has discovered that an electric motor of the Siemens pattern, driven by a bichromate battery, the whole not exceeding the weight of three men, is capable of furnishing regularly for three consecutive hours the work of nearly fifteen men.

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But other uses are gradually being found for gas, not the least important of which is the furnishing fuel for electric motors. For there is good authority for saying that a larger candle-power may be had from the electricity generated with gas as a fuel than could have been obtained from the gas directly used.

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There are several journals devoted to the gas interest, and we look through their often well-written pages, not only to see how the production of gas is being effected by the growing popularity of the electric light, but also to see how the gas people explain their want of success when they make a direct issue between their product and electricity. We must confess to have been frequently filled with admiration at the ingenious manner with which the editors of these journals can get around a direct issue wherein their favorite product has, in a fair trial, met with what might not inappropriately be described as a young Waterloo.

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In the current number of one of these journals, we saw an article with the attractive heading, "Is Electricity Cheaper than Gas?" Now, as we are by no means antagonistic to the gas interest, or any other for that matter, but are a firm believer in electricity solely because of a conviction that it will prove, as an illuminant, superior to carburetted hydrogen gas, to the so-called water gas, or any other gas, it was therefore with pleasure that we began to read the article in question, to see what proofs, if any, could be adduced to show the superiority of gas.

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After considerable circumlocution, in which the writer declares substantially that a 26-candle power gas jet will give greater luminosity than a 16-candle power incandescent electric light, and inferentially dares any one to dispute his assertion, he instances, as a proof of the superiority of gas in general, and water-gas in particular, an incident which, he says, occurred recently at West Manayunk, and we trust he will overlook what, no doubt, will appear to him great ignorance on our part, when we confess that we never heard of the place before.

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In the absence of proof to the contrary, we will take his word for it that there is such a place as West Manayunk, and that it is on this continent, presumably in the United States.

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And now to the argument, that gas is superior to electricity.

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He says: "A certain mill now being lighted by gas was offered the electric light for thirty days, upon condition that at the end of that time, if it should be found as good as gas and cheaper, its use would be continued. Arrangements had been begun when the agents of the light, which was being furnished by a New York concern, for the first time saw the mill lighted up by the gas. He asked:

"'What does that gas cost?'

"'One dollar and a half per thousand feet!'

"'That's enough. We can't beat that light at that price!'

"And the sharp agent at once ordered the work stopped, unwilling to compete with good gas at a fair figure."

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He ought to have added: "Hence gas is cheaper than electricity." *Quod erat demonstrandum.*

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This will, we think, be admitted to be one of the most remarkable arguments on record.

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Without wishing even to imply a doubt as to his correct statement of the facts, and admitting, for the sake of argnment, that electric light companies employ agents to go about the country loudly proclaiming the superiority of gas over electric light, both as to luminosity and from an economical standpoint, I would like to ask him a plain question. If, in West Manayunk, the gas people can get a dollar and a half per one thousand cubic feet for their product, and then undersell the electric light people, how is it that in New York, for instance, where gas is sold to large consumers at about seventy-five cents the thousand, it is being gradually replaced as an illuminant by electricity?

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We do not wish to be understood as saying that gas is being forced out of the market by electricity. By no means.

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For a thriving, enterprising electric light company of few words and big undertakings, we take the liberty to commend the Fuller Electrical Company. There is not a little difference between the conduct of this company and that of some other electric light companies in this neighborhood. When the officers of one of these latter companies make up their mind to do something, they go out to the highest hill, and flap their wings and blow their horns with great gusto and vehemence. The newspapers are invited to send reporters to hear what great things they are going to do, and into the willing ears of these gullible gentry a not inconsiderable amount of a saccharine but innutricious article vulgarly called "taffy" is poured.

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The public wonders that the great things it has read of do not come to pass; that one excuse after another is given in lieu of fulfillment, forgetting meanwhile that they have been reading only the annual proclamation of the Fog Horn Electrical Light Company, or the Isolated Electrical Blowhard Company.

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Now, the officers of the Fuller Electric Light Company have, from the start, pursued an entirely different policy. When they have a contract, they go in and carry out its terms, and talk about it afterwards. They have undertaken only that which they were able to perform, and have, therefore, made few blunders.

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The *Revue Electrique* is our authority for saying that Dr. Siemens, in his address to the London Society of Arts, showed that arc lamps were cheaper than incandescent lamps and that both would be decidedly cheaper than gas lighting if the electric companies had the opportunity to make sufficiently large plants, and the gas companies continued to pay their present large dividends.

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Dr. Siemens seems to have said this before the recent experiments in the electrical transmission of power made by Deprez in the work-shops of the *chemin du fur de nord*. If the results of these experiments have not been exaggerated, and ten horse power, minus fifty per cent. may be transmitted 21½ miles, it would seem as if the gas companies, so far as illumination is concerned, were in the future to "take a back seat" to use an expressive though inelegant slang phrase, and even if they could recover a greater energy of the coal than could be had by means of a steam engine while driving an electric generator—even then I say they would find themselves though perhaps in the right church, certainly in the wrong pew.

### Berly's Electrical Directory.

We have received the above work—its name in full being "J. A. Berly's British, American, and Continental Electrical Directory and Advertiser, 1883"—and find that in comparison with the first edition, which was issued last year, it is indeed a "Burly" volume.

It is a handsome octavo book of 664 pages, with contents of a character both varied and profuse, and we should say that the book will prove an invaluable companion and work of reference for all who are in any way interested in the practical applications of electricity.

That the Scriptures might be fulfilled, and that the last might be first, the preliminary pages are filled with a list of names received

too late for insertion in their proper order. After this comes a review of the progress of the past year in all branches of electrical science, including the new books relating to the subject which have been published in 1882.

Next we find a collection of tables and formulæ, some of which "no feller can understand," while others are plain, and therefore useful. Amongst the latter we find definitions of the electrical units of measurement; resistance and weight tables for different gauges of wire; differences of time between Greenwich, and a couple of hundred of other places, and the American, International, and Universal Morse alphabets. Pages 125 to 163 are given up to the British trade directory, not only of the vocations and pursuits relating nearly to, and depending upon applied electricity, but also of many so remote that their relationship is chiefly imaginary.

The personal British directory of electricians, engineers, etc., is very complete, and is comprised in 108 pages.

The Society of Telegraph Engineers and Electricians is represented by the full board of officers and members, the latter list commencing with Sir George Biddel Airy, and ending with Mr. J. D. Shadwell.

One of the most useful features of the book is the list of British-American publications, with the publishers and prices (pages 337 to 342); the German text-book being catalogued towards the end of the volume.

The American part of the directory extends from page 425 to 588, and includes a complete list of the telephone exchanges of the country; and the book concludes with the French and German departments, which, although not so complete as the Anglo-Saxon classes, still represents the Teuton and the Gaul fairly.

We notice some names under the different headings in the American section which are quite out of place and very misleading, the persons being in no way connected with the pursuits to which they are credited, this sort of surreptitious advertising is of course very annoying and unjust to those who are legitimately engaged in the pursuits in question; the addresses of many of our prominent manufacturers are not given correctly, nor do we find them in all cases arranged under the proper heading, while others are entirely ignored. To make this section of very much value it must be thoroughly overhauled and rearranged.

The publishers, Messrs. Dawson & Son, 121 Cannon street, London, will no doubt succeed in doing this before the next edition appears.

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On the subject of Telephones Sir Frederick Bramwell, F. R. S., delivered a lecture in London recently, a portion of which we give herewith:

"Prior to the invention of the telephone, by making and breaking contact at the transmitting station sounds had been produced at the receiving station—such as the striking of bells, or the vibration of a Morse sounder—but these were independent of sound at the transmitting station, and they varied according to the implement used at the receiving station, and were and are used for purposes of audible telegraphy. Also, prior to the invention of the telephone, it was possible to reproduce at the receiving station, say by a tuning-fork, the vibrations of which break and make contact, the same note produced by a similar tuning-fork at the transmitting station; and in this case there was a reproduction at the receiving station of the sound at the transmitting station. But the only thing that was insured was the repetition of the same note—there was no reproduction of the same sound. For example, the note might have been uttered by a violin-string, by a tuning-fork, or by a clarionet at the transmitting station; at the receiving station, however, nothing would be given forth but the note of the particular tuning-fork, or other vibrating implement, which was in accord with the number of the vibrations transmitted in a given time. All these modes were due to the variations of the current caused by break and make in the circuit, and were therefore abrupt. The best result obtained with such an agency was in the machine of Reis, who, in 1862, reproduced tones, and it is said some words were heard. That machine received no development, and telephony lay dormant for fourteen years, until the invention of Prof. Graham Bell, patented in this country in December, 1876. In 1874 Mr. William Henry Barlow, F. R. S., Past-President Inst. C. E., turned his attention to the recording of the vibrations produced by speech. He effected this by means of an instrument called a logograph. This was communicated to the Royal Society, and exhibited in operation there. By its agency there was depicted on a traveling band of paper the motions derived from the vibrations of a membrane under the influence of speech; but had the results been known they would probably have deterred an inventor seeking to produce a telephone, as it appeared the vibrations were not always the same for the same syllable, but varied with the speaker and from the circumstances. Prof. Graham Bell graphically represented the vibrations in the electric current, either direct or reversed, caused by break and make, and showed that these were too abrupt for his purpose—namely, the reproduction of articulate speech. He proposed to attain the object sought by having the circuit always closed, and by causing rises and falls, or reversals, as the case might be, of electricity which should be made gradually, instead of abrubtly, as before. The simplest mode in which he attained this end was in one of the original forms of the Bell transmitter or receiver (for the instrument was capable of fulfilling either function) by placihg an iron or a steel plate in the neighborhood of a permanent magnet surrounded by a coil of insulated wire, so that on the plate being set into vibration by the voice it should induce, in the coil, reversed currents of electricity which could travel along the wire in prolongation of the coil to the coil of the similar instrument at the receiving station, thereby varying the power of the magnet at that station and setting up vibrations in the corresponding iron disc. This disc, acting upon the air, gave to it vibrations similar to those which had put the first disc into motion, and, in that way, a reproduction of the original sound (as Prof. Bell said a *fac simile*) was obtained. Other modes were employed by him, such as the use of a battery in the line-wire, and, best of all, the use of two local batteries to send the current to a primary coil round a core, the line-wire being connected with secondary coils acting by induced electricity. As transmitters these instruments were necessarily somewhat feeble, since the whole of the electricity in the first of the three cases mentioned, and what might be called the operative electricity in the other two cases, had to be derived from the microscopic movement of the disc, under the influence of the sound-wave produced by the speaker.

"Edison's phonograph was exhibited in order to show that a disc, when caused to vibrate under speech, could by a central needle impress those vibrations on tin foil, and that on the tin foil being caused to traverse under the needle, the reproduction on the disc of those vibrations caused it to repeat the speech which had originally set the disc into motion. This was appealed to as a convincing proof that a disc, when mechanically vibrated in a manner corresponding to the vibrations which had been imparted to it by speech, was sufficient, wholly irrespective of any electrical agency, to impress upon the air the needful vibrations to reproduce speech.

"Edison then devised a transmitter, wherein the disc need not be metallic, but might be mica, and its vibrations were caused to operate upon a small block of carbon, which carbon was introduced in the circuit of a battery. It was thus found that the almost inappreciable variation in pressure due to the vibration of the disc was sufficient, for some not very well-understood reason, to alter the conducting power of the carbon, and to cause varying currents to be transmitted along the line-wire to the Bell receiver at the opposite end. At the present day the universal transmitting instrument for commercial purposes is the carbon transmitter of Edison, or some modification thereof.

"Professor Hughes' microphone was next alluded to, and it was stated how by its means the most minute sounds were rendered audible, and how, from the delicacy of the instrument, it was applicable to many scientific purposes.

"Edison's chalk receiver was subsequently explained. Prior to Edison's time, it had been known that the friction of certain surfaces varied with the electric current passing through them, notably under such circumstances, the friction of the human tissue. Among other appropriate substances prepared chalk was one, and it was shown how Edison availed himself of this. By attaching a stem to the center of the disc, and pressing this stem by means of an adjustable pressure upon the periphery of a chalk cylinder, a current of electricity passed from the center of the cylinder through the stem. Upon the cylinder being turned by hand the friction on the stem caused it to move the center of the disc—its edge being fixed—to a definite position depending on the friction and on the rigidity of the disc; but, on a variation in the current, the change produced thereby in the friction caused the stem either to be drawn in further or to yield to the elasticity of the disc and to allow it to be moved backwards. In this manner vibrations were set up in the disc corresponding with the vibrations of the transmitter that had sent the varying electrical currents. As in the case of this receiver, the power was derived, not from the electricity, but from the hand of the operator turning the chalk cylinder, very considerable loudness was obtained, so that the utterances of the receiver were audible in a large room.

"Mr. Shelford Bidwell having been good enough to lend a photophone, that beautiful invention of Prof. Graham Bell was explained. Mr. Bidwell showed how, by speaking to a disc, the front being a mirror, on which a powerful light was directed, that light could be reflected on to a selenium cell, and as the disc vibrated under the influence of the voice the light playing on the selenium cell varied. Selenium was a material the conductivity of which changed with the amount of light upon it. It was therefore possible in this manner to cause a Bell receiver to speak, and reproduce the speech which had been uttered to the mirror disc. It was pointed out that in this manner there was no need of a wire connection between the transmitter and the receiver, the passage of a beam of light being all that was required.

"Reference was then made to the various purposes to which the telephone might be put, and to the exchange system and the necessary apparatus for receiving the calls and making the connections between the different subscribers to the exchange. Amongst special uses, a very interesting one was shown—that of the application of telephony to the diver's helmet. Thanks to the kindness of the captain of the H. M. S. Vernon and of Mr. Gorman, a helmet with the whole of the apparatus was exhibited. It was shown how the application of the telephone in no way introduced any complication, as the single wire needed was in the middle of the old call-rope, the return being made by the water itself. Thus, if the telephone went wrong, the diver was left without additional apparatus of any kind to encumber him, and yet with all the resources that he would have had in the absence of the telephone.

"It was stated that the development of the telephone had been far more rapid in America than in England. As an instance, it was mentioned, that in the city of Washington, with a population of about 120,000 white persons, as many as 800 telephones were used.

"Then a return circulated that very day by the United Telephone Company, was read, showing that on the 28th of February, in the year 1881, there were independent of private lines, 845 subscribers to the London Exchange; that on the same day in 1882 the number had increased to 1,505—or an addition of 660; and on the 29th of February this year, the number was 2,541, or an addition of 1,036; and that contemporaneously with these increases, the use of the telephone by each subscriber has augmented, until it now reached more than 7½ calls per day for each subscriber, which, at a cost of £20 per year, represented only two pence a call; or, bearing in mind that each call involved a return message, it only amounted to one penny for the message sent each way.

"The lecturer was fortunate in having the assistance of Mr. E. H. Johnston, who had been so much associated with Mr. Edison in carrying out many of his inventions, and who was kind enough to put into work both the phonograph and the chalk receiver."

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A great deal of disappointment has been expressed because Hartford is so far behind other cities in the matter of electric lights. People see them elsewhere and think they ought to be here. If they can be maintained in other places, they can here. And so they argue. But the matter is just here. Hartford will have the electric light, and have it in all its novelty and splendor. But there's no need of haste. There are wise conservatives advising. So far, electric lighting has been only experimental. This system of illumination is not yet fully understood, but Hartford parties are soberly looking on and profiting by the experiences of more impulsive people, and when the right time comes, the right kind of an electric light will be introduced here for general use, and the bill of expense for experiments will have been paid by those who taught Hartford how to avoid them. Be patient.

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### Storing Electric Energy.

(*Continued from page 5, March 22d.*)

The decomposition of alkalies does not require a powerful voltaic arrangement. Iodide of potassium may be decomposed by a single pair of plates feebly charged, but for producing decomposition in most solutions not less than three cells of battery should be employed.

The decomposing power of a ray of light upon one of a pair of iodized silver plates, immersed in water, in the dark, will cause a galvanometer to be deflected. The plate upon which the light falls becoming positive.

A self-charging secondary battery was made by Prof. Grove in 1845, and is described as follows: "The glass cells to contain the acid water are open; the hydrogen tubes, of which one is in each cell, all enter a common glass tube, which is above them, like the hydraulic main in a gas work: one end of this tube is closed, and the other is connected with a generator of hydrogen similar to that of Dobereiner's apparatus; by this means the supply of hydrogen is constantly maintained. The platinized plates are in each tube, and other plates, properly connected, are immersed in the acid liquid of the cells, which being exposed to air, keeps up the supply of oxygen Mr. Grove's experiments show that the most invariable action can be relied on for years."

A self-charging apparatus is described in Il Cimento, Ann. iii, 1845, as follows: "M. Marianini took five Leyden jars coated with zinc outside and with silver inside; he placed them one within the other, and made communication between the inner coating of the innermost and the outer of the outermost, by means of a silver wire, and the apparatus charged itself. His test of charge was the contraction of a frog placed in the circuit."

The galvanic battery, and in fact the whole science of galvanism, reverts for its origin to the interpretation which Prof. Volta placed upon the simple, laboratory experiment by Galvani, and the republication of the experiments by Grove and Marianini in this age of practical application of every means for producing and utilizing currents, may lead to the construction of a self-charging pile that will actuate clocks, or serve for occasional ringing of bells.

Charles Kirchhof, previously referred to, states that electrical energy may be stored from friction machines, and by connecting

easily charged batteries between a lightning rod and the earth.

In a letter written by Prof. Winthrop, of Cambridge, Mass., to Benj. Franklin, bearing date September 29, 1762, he says: "There is an observation relating to electricity in the atmosphere which seemed new to me. I have some points on the top of my house, and the wire where it passes withinside the house is furnished with bells, according to your method, to give notice of the passage of electric fluid. In summer these bells ring at the approach of a thunder storm, but cease soon after it begins to rain: in winter they sometimes, though not very often, ring while it is snowing, but never, as I remember, when it rains. But what was unexpected to me was, that, though the bells had not rung while it was snowing, yet the next day, after it had done snowing, and the weather had cleared up, while the snow was driven about by a high wind, west or northwest, the bells rung for several hours briskly as I had ever known them, and I drew cousiderable sparks from the wire."

The action described by Prof. Winthrop would seem to be too intermittent to be utilized, but constant currents may be obtained from plates of copper and zinc, or iron, buried in the earth, the effect from which might be supplemented by the atmospheric currents, which are nearly always present and sometimes intense, as during what are termed magnetic storms.

The constant product from belts and machinery in factories can, without doubt, be utilized, and a waste product turned to account for lighting the factory, or adjacent buildings, or for other obvious uses.

The constant discharge of electricity from the belt can be passed into secondary batteries containing an easily decomposed electrolyte, or the sparks can be first accumulated in a Leyden jar, and sent with more quantity effect into the secondary batteries. While advantages might be gained by modifying the Leyden jar by making it resemble more nearly Marianini's apparatus, or an easily charged secondary battery; care should be taken to insulate the apparatus perfectly.

Twenty-eight secondary batteries of forty pounds weight each will maintain twenty incandescent lamps of eight candle power each for twenty hours. With forty such batteries ten incandescent lamps of twenty candle power each can be maintained for ten hours. In the latter case an average of eight pounds of battery maintains a candle power of light for ten hours.

When the size of each battery is increased and the number of batteries remain the same, a very much larger number of lamps can be maintained. Thirty-three cells of secondary battery, each weighing 300 pounds, sustained 201 twenty candle power lamps at their full capacity of incandescence. To light one such lamp properly would require the same degree of energy, or nearly so, but to light one such lamp would not require very large cells.

Lamps of low resistance and large light-giving surface can be made incandescent by a less number of cells of secondary battery, of large size.

It is possible to change these batteries from a few cells of gravity battery, but to accomplish satisfactory results a dynamo machine is necessary, and the constant current dynamo-electric machines adapted for plating give good results.

A small Gramme machine of the A type, having an internal resistance of 4.58 ohms, and with an external resistance of 4 ohms, gives an electric current of 17.5 webers and an electro-motive force of 158.5 volts, giving an amount of work equivalent to 2 H.P. =8 times the energy of 40 cells of Grove.

If we wish to replace such a machine by Grove's cells, we should have to arrange about 80 cells to get the same electro-motive force, and to make each cell about four times as large, or to arrange 320 cells in four sets of 80 in each set, to get the same amount of external work done as by the Gramme machine. This will show how impossible it is to do the work by voltaic batteries which can be done by magneto-electric machines.

When a dynamo machine is used for charging, the machine should be placed in the circuit with the secondary batteries in a developed condition.

As it requires a brief interval of time for a machine to speed up and to build up a current in its field of force magnets, and, as the secondary batteries, after having been used, retain a residual charge of no mean character, if the machine was connected into the circuit with these batteries before it had gained a proper speed, and before it was producing a current sufficient to charge the batteries, the residual charge in the batteries, acting instantly, would set up a current through the helices of the machine, and magnetize it in the wrong direction.

To overcome this difficulty the machine can be run on a developing circuit. Then one current from the machine can be split through the charging circuit which includes the secondary batteries, and then the developing circuit can be broken, and the machine be left in the charging circuit with the secondary batteries, producing a current that will not be overcome by the batteries.

This described manipulation of the circuits can be accomplished, automatically, by a ball governor, or by an electro-magnetic switch actuated by the current of the machine when it has become sufficiently powerful.

*(To be continued.)*

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The conclusions of the New England Cotton Manufacturers were: "Electricity forms the safest method of illumination when the following particulars are observed: The system insulated throughout, so that there be no earth communication, or from one part of the apparatus to the another, except through the proper conductors. All switches made with a lapping connection. Arc lamps provided with globes, closed underneath, and the frame so arranged that the lower carbon cannot fall out, even if the clamp fails to hold it securely."

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The newspaper is a mirror, into which people look to see something of themselves reflected. If in that mirror their follies and errors are made to seem wisdom and virtue, then harm is done. If, on the other hand, they are shown their mental and moral images without favor or prejudice, the effect is helpful. Fidelity is still the test of the glass.

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The *Electrical Review* is the new name of a handsome 16-page weekly journal, which proposes to deal with electric lighting, telephone, telegraph and electrical matters generally. The paper was formerly published semi-monthly under the title of *Review of the Telegraph and Telephone*. In shortening its name and broadening its field, the managers show appreciation of the growing importance of electrical discovery, and the first number issued under the new auspices promises well for the future. The paper has been enlarged to 16 pages and the same sized page as the AMERICAN MACHINIST. George Worthington continues in charge as editor, while Thomas H. Delano, a gentleman long and favorably known in newspaper circles is publisher. The paper will be published at 23 Park Row, New York, by Delano & Company. Subscription price, $3.00 a year.—*American Machinist.*

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THE CALCUTTA INTERNATIONAL EXHIBITION will be opened December 4th, 1883. Exhibitors from the electrical and mechanical fields will serve their interests by consulting the prospectus sent out by the U. S. Department of State. Section G of the prospectus classifies by numbers the exhibits desired, and covers the whole of the mechanical arts and electrical sciences. Among the industries mentioned are telegraphy, telephones, means of producing artificial light and electroplating, beside motors of all descriptions, railways and tramways. Our electricians and others interested in these growing electrical industries in America should bestir themselves and make a superb showing, as they can, in this new locality. Prospectus and "application for space" will be sent from our office, postpaid, when required.

## Simultaneous Transmission of Telephonic and Telegraphic Messages on the Same Line.

The certificate of incorporation of the Telephonic Telegraph Company was filed in the County Clerk's office in this city on Wednesday last. The object of the new company, as stated in the certificate, is to construct and use lines for telegraphic and telephonic purposes between this city and San Francisco, and this city and the cities of Quebec, Montreal, Hamilton and Toronto, Canada. Its capital is $:00,000, divided into 1,000 shares, which are held as follows: Erastus Wiman, 332; Dr. Abner M. Rosebrugh, of Toronto, Canada, 332; George Black, manager of the G. N. W. Telegraph office in Hamilton, Canada, 332, and John Moss, John T. Kennedy, Hugh Morrow and William D. Wilson, each one share. The instrument used is the same invention of Dr. Rosebrugh and Mr. Black, and has been several times referred to in this journal.

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Baxter's telephone transmitter and receiver patents are owned by the Overland Telephone Company, of New York City.

## The New Sound Steamer.

The new iron steamer Pilgrim, built by John Roach & Son for the Fall River line, has been furnished with the Edison electric light, and was illuminated and thrown open to public inspection on Tuesday evening last. Nine hundred lamps burning on the various decks gave the steamer a brilliant appearance. The forward part of the main deck is lighted by a liberal distribution of one-light brackets, the lamps in exposed positions being protected by wire cages. The saloon on the after part of the same deck has several ornate brass chandeliers, of from six to eight lights each, suspended from the center of the roof, while along the halls is a row of two-light brackets. The newels at the foot of the stairway leading to the main saloon are each surmounted by four-light brackets in red shades, and those at the head of the stairs support five-light brackets in green shades. One central chandelier of 36 lights and two side ones of 27 lights, and two smaller chandeliers further aft, render the main saloon dazzling. Another 27-light chandelier and numerous two-light brackets light up the same saloon forward of the engine-room. Each of the larger state-rooms is lighted by two single-light brackets, and each of the smaller rooms by one single-light bracket. The lights are supplied from two mains running along either side of the boat, and half of the lights of each chandelier are connected with each main, so that any derangement of the wires of one main will only partially affect the lighting of the boat. Three boilers, two engines and three dynamos are provided to guard against any possible failure of lighting power. The Pilgrim is the largest boat of the Fall River line. Her length over all is 387 feet; beam, 50 feet; beam over guards, 87 feet; depth of hold, 14 feet. She has two saloon decks above the main deck and 280 first-class state-rooms, with accommodations for 560 passengers. She is licensed to carry in all 1,200 passengers. She has a beam engine of 5,000 horse-power, with a cylinder of 110 inches diameter and 14 feet stroke. It is expected that she will make 20 miles an hour. The saloons are fitted up with mahogany, and the ceilings frescoed in delicate and cheerful colors. The state rooms are furnished with folding beds and electric bells, and the doors are secured by locks that cannot be opened with pass keys. Many of the state-rooms are connected with each other, so as to be thrown *en suite* for the convenience of families. Although finished, the Pilgrim has not yet been supplied with furniture. This will be put on board at Newport, and for that purpose she will go there probably next week.

## NEW PATENTS—ELECTRICAL—1883.

INDEX OF INVENTIONS FOR WHICH LETTERS PATENT OF THE UNITED STATES WERE GRANTED IN THE WEEK ENDING MARCH 13th, 1883.

273,739 Electric battery; Paul Jablochkoff, Paris, France.
273,888 Electric arc lamp; Ludwig Piette and Franz Krizik, Pilsen, Austria-Hungary.
274,023 Electro-magnetic car brake; Harvey S. Park, Henderson, Ky.
274,074 Electric testing apparatus; Charles J. H. Woodbury, Lynn, Mass.
273,751 Galvanic battery; Lyman D. McIntosh, Chicago, Ill.
273,704 Incandescent electric lamp; Alex. Bernstein, Boston Mass.
273,839 Junction box and connection for electrical conductors; John Kruesi, Brooklyn, N. Y.
273,714 Magneto-electric signalling apparatus; Thos. A. Edison, Menlo Park, N. J.
273,810 Printing telegraph; William J. Burnside, Hilcot Court Road, Lower Norwood, Co. of Surrey, England.
273,826 System of underground conductors for electrical distribution; Thos. A. Edison, Menlo Park, N. J.
273,855 Secondary battery; Nathaniel S. Keith, New York.
274,082 Secondary battery; Charles F. Brush, Cleveland, O.
273,726 Telegraphic receiving instrument; Emery M. Hamilton, New York.
274,075 Telephone transmitter; Robert D. Woodworth, Orange, N. J.
273,869 Underground cable; William McMahon and Timothy G. McMahon, Charlestown, N. H.

**A printed copy of the specification and drawing of any patent to the annexed list, also of any patent issued since 1865, will be furnished by any of the patent solicitors whose advertisements appear in this journal. In ordering please state the number and date of the patent desired.**

## Business Notices.

The attention of persons interested in local telegraph and telephone organizations is respectfully called to the electric lighting system of The Fuller Electrical Company, and the practicability of making arrangements with that company for the introduction of its apparatus, either in isolated plants, or through the formation of local companies desiring to engage in the business of electric lighting. The specially valuable feature of this company's system may be seen by examination of its apparatus in Boston, Worcester, Providence, Hartford, New York City, Brooklyn, Jersey City, Paterson, Philadelphia, Lancaster, Scranton, Syracuse, Rochester, Buffalo, Pittsburgh, Wheeling, Steubenville, Xenia, Dayton, Grand Rapids, Chicago, Springfield, Belleville, St. Louis, St. Paul, and many other smaller places throughout the country. Correspondence is invited.

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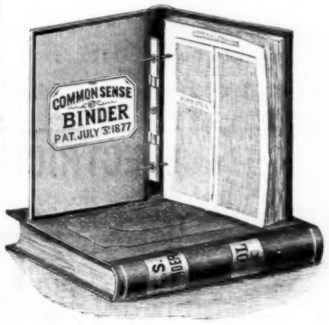


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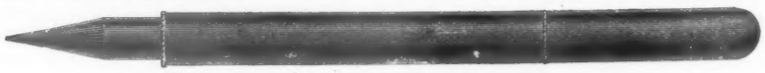

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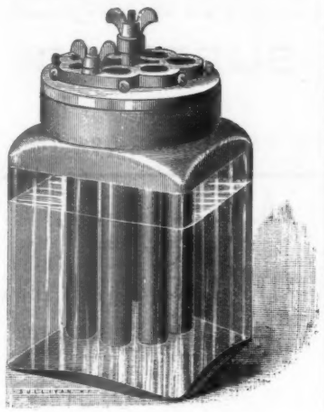

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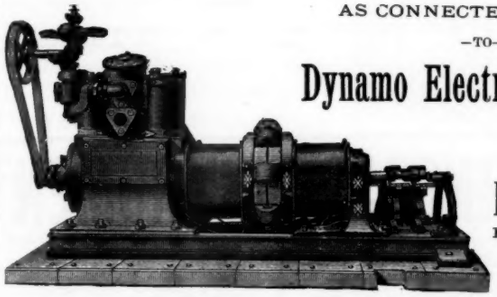

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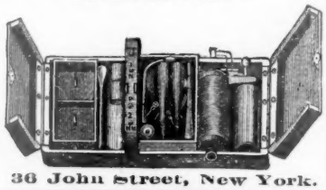

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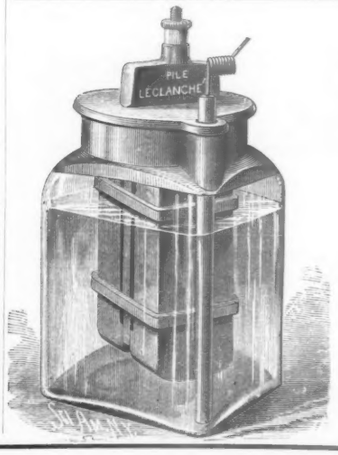


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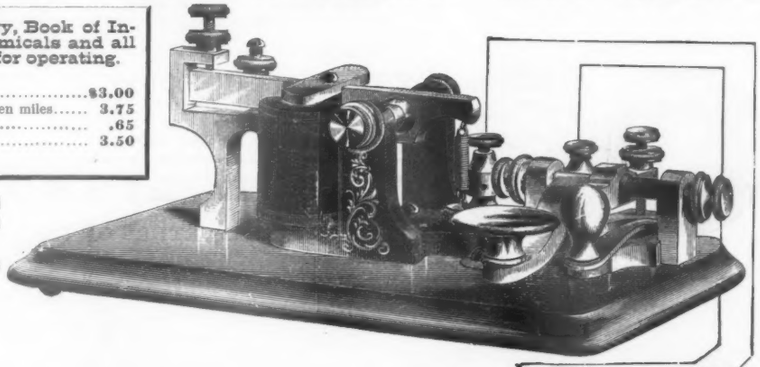

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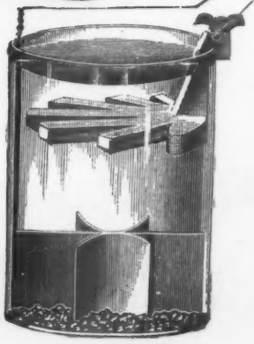

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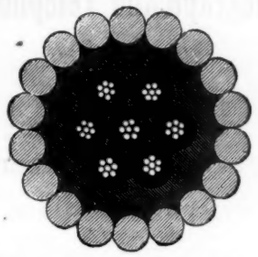

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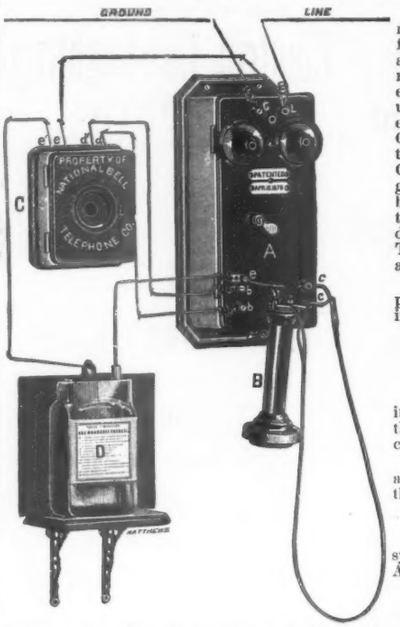


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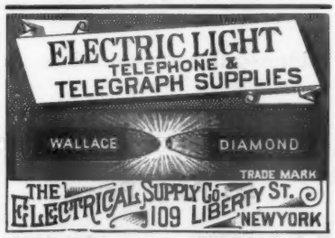
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